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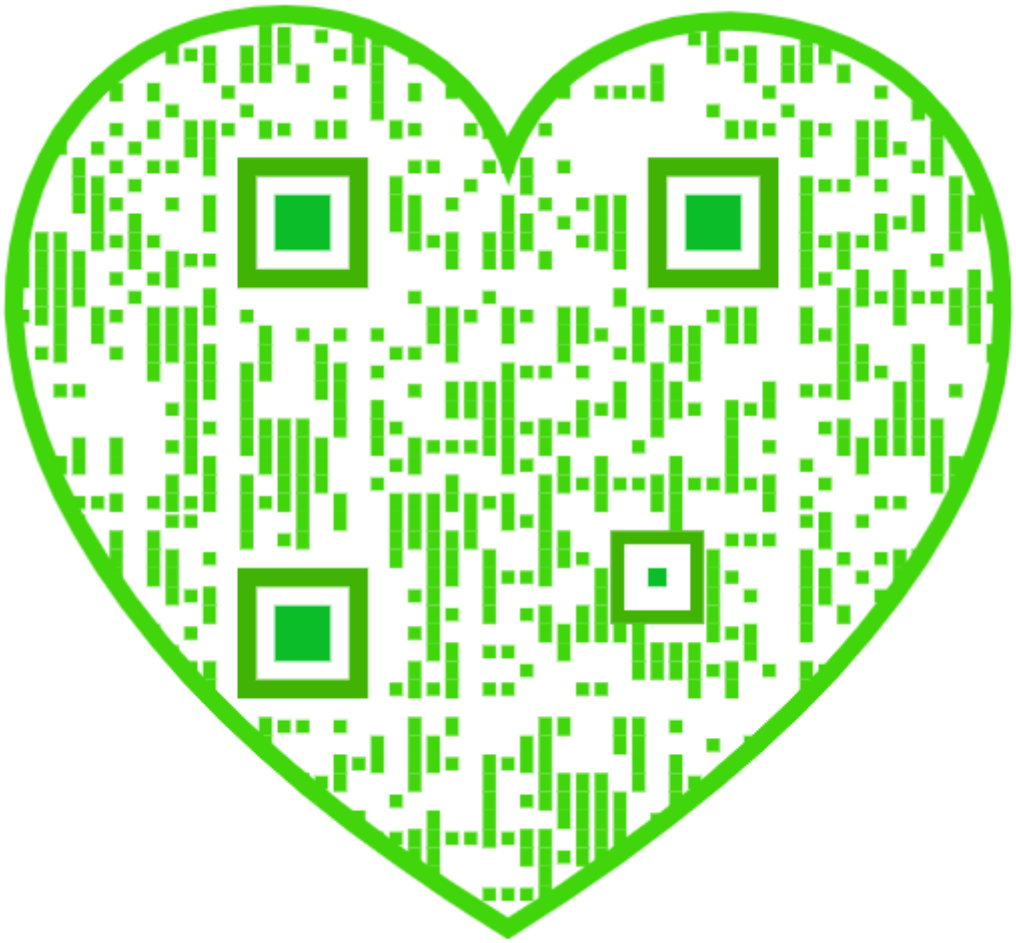

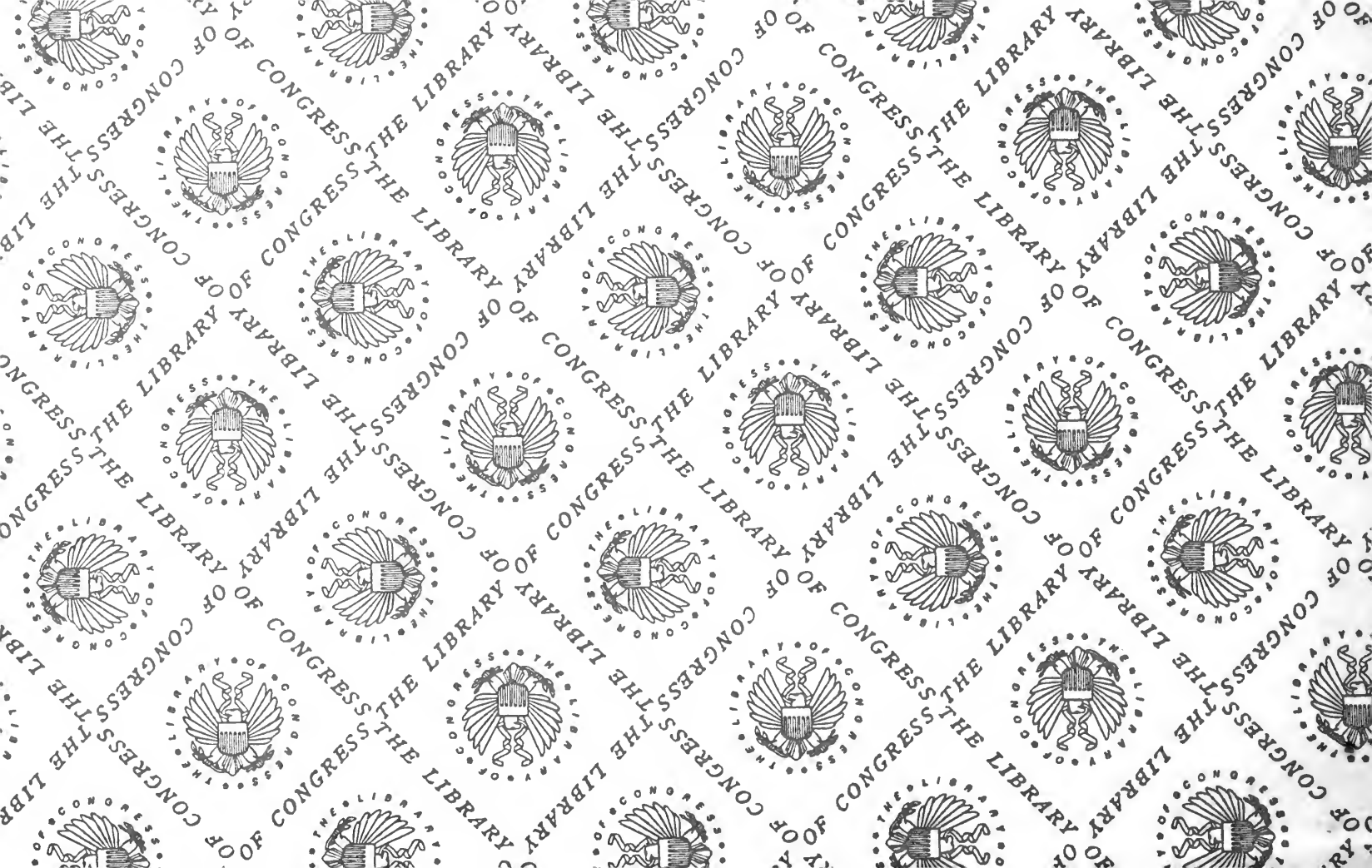
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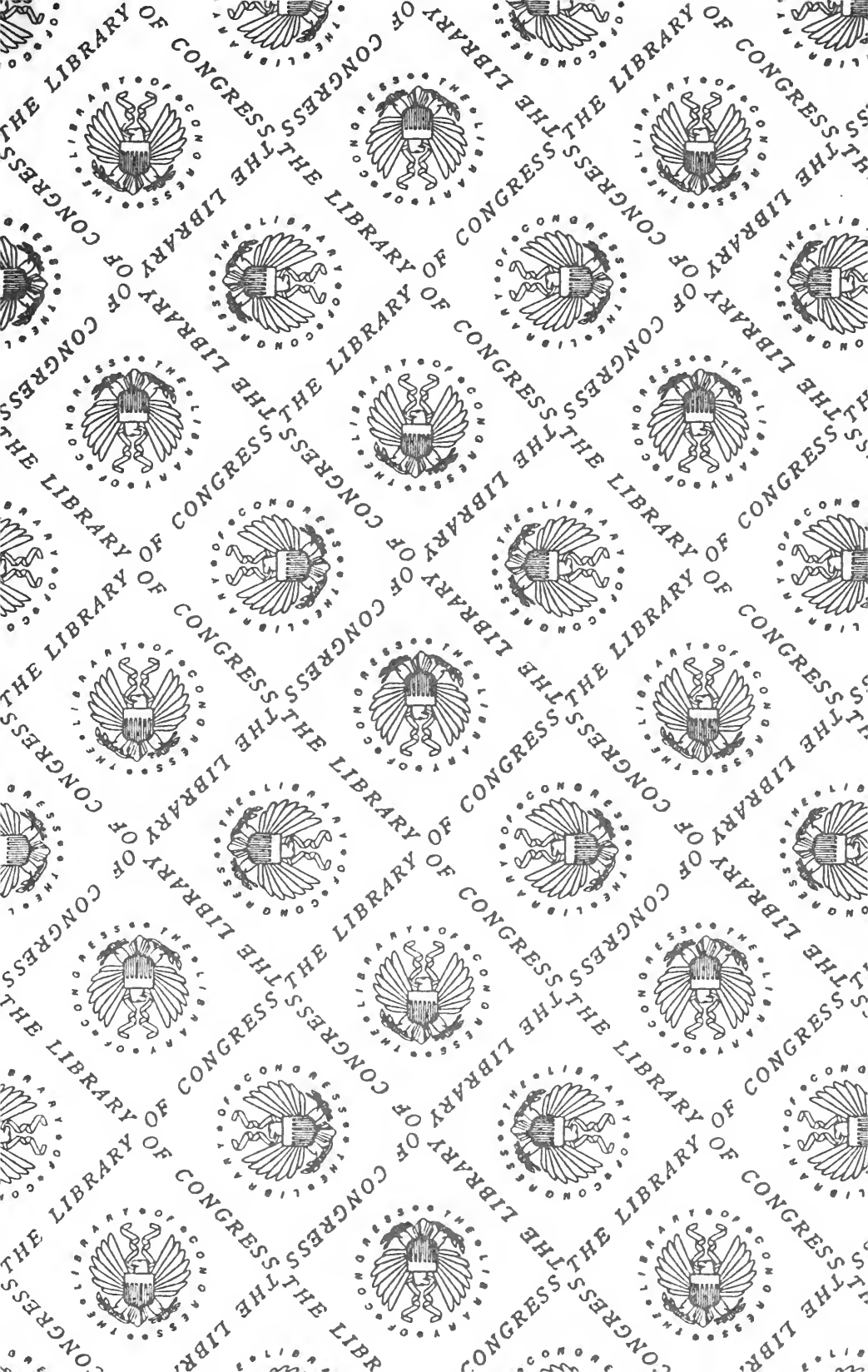
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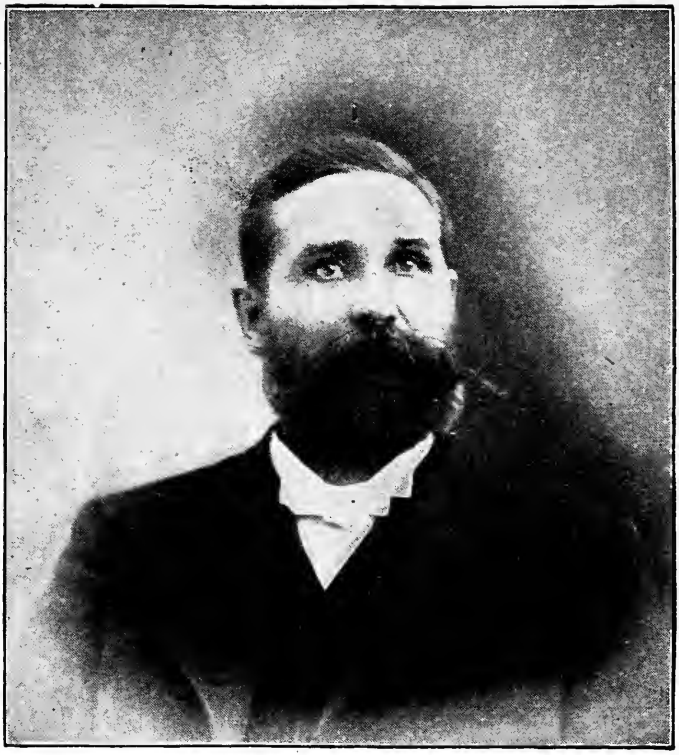

J. G. Holmström

STANDARD BLACKSMITHING, HORSESHOEING AND WAGON MAKING

CONTAINING:

Twelve Lessons in Elementary Blacksmithing, Adapted to the Demand of Schools and Colleges of Mechanic Arts.

Tables, Rules and Receipts Useful to Manufacturers, Machinists, Engineers and Blacksmiths.

A Rational Treatise on Horseshoeing and the Anatomy of the Foot of the Horse, Suited to the Demand of Horseraisers, Veterinarians, Farriers and the Amateur Horseshoer.

——BY——

J. G. HOLMSTROM

AUTHOR OF "MODERN BLACKSMITHING."

PROFUSELY ILLUSTRATED.

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PREFACE.

The author of this book has been prompted by two reasons in the undertaking: First, the phenomenal sale of his first book, "Modern Blacksmithing"; second, by the many letters asking for information on such work as was not treated in that book.

People in general are not aware of the fact that, in our time of manufacture, blacksmithing is almost a lost art, for nearly everything formerly made by the smith is now turned out by machinery. I have never been in a community yet where I did not hear this remark about the smith: "Oh, he is a good smith;" while the fact is, in many instances, that there was not a real smith within hundreds of miles, and they might very appropriately have joined in the lamentation of old, "There is no smith found in all the land of Israel."

I think I am safe in contending that not one out of a thousand smiths can make horse nails, which are the simplest articles formerly made by the smith. It takes the author only about three minutes in a shop to tell if the smith who stands behind the anvil is a real smith or a botch. It takes an educated graduate from a medical college just that long to discover a fake doctor who has no education, but has crept into a profession he knows nothing about. Just so, the average smith has opened up his shop after a three-months apprenticeship, and in some cases not even having served that long; but if the people but knew the difference, they would insist on an apprentice law. As it is, we shall only modestly ask every prospective shop opener to study and learn, partly by heart, the teachings given in "Standard Blacksmithing, Horseshoeing and Wagonmaking," and we shall have a better class of smiths in the future.

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CHAPTER I.

INTRODUCTORY.

"If the iron be blunt,
And he do not whet the edge,
There must be put to more strength."

—*Solomon.*

Only ten years ago, the blacksmiths, wagonmakers, and horseshoers who read a trade journal, or a book devoted to their trade, were few and far between. It is not what it ought to be now, but it is moving in the right direction.

What would a person think of the physician who boasted of the fact that he had never read or subscribed for a medical journal? We would not trust him to experiment with our health, much less place our lives in his hands, when we knew that the time spent by a medical student at the college is hardly enough to acquaint him with the names of the different diseases and herbs used for medicine. The healing of diseases is something he must learn through practice or experiment. Then, if he is too selfish to profit by the experience of others, he must begin the experiments himself; and that means that many must die to make this man wise. We have this class of self-sufficient people in all walks of life; and mark it down, they never will amount to much. There are mechanics who know all the latest rules and tricks of sport life, from prize fighting and foot ball down to solitaire, but they have never learned the A, B, C of their trade. These are, as a rule, the "knockers," the men of "great cry and little wool," men who have mastered an "ism,"—braggardism.

But it is consoling to know that this species is dying out fast, for here, as everywhere else, "only the fittest will survive."

Solomon dubbed the blacksmith "father of all mechanics"; and so he is, and he can point back to Tubal Cain as the first artificer in his trade. We would expect that followers of such a trade should stand at the head and in the lead, when it comes to intelligence and general knowledge, in comparison with other mechanics; but I am not sure that he does. Only 20 per cent. of the blacksmiths of the United States have read a book or a magazine devoted to their trade, and when we look at other countries it is worse yet; but an awakening has begun, and I hope the smiths will remember to "strike while the iron is hot."

Of course, trade journals should be read with discrimination, for these papers are edited by men without practical experience; hence we find many misleading articles appear from time to time.

There is, so far, a lack of system in our trade. We have no authority. Every beginner imagines he is the best mechanic in the land, and what he does not know is not worth knowing. I often hear this remark from people in other walks of life: "He is a good mechanic; he is the best blacksmith in the state;" while the fact in many a case is that he is the biggest lubber and bungler in the state. I never saw a man, no matter how poor a blacksmith, but what some one would think him a master in his trade. I hold that there is no trade where there is so great a per cent. of poor workmen as in the blacksmith's trade, because the blacksmith's trade is a hard trade to master, and, no matter how clever a young man might be,

he will never be an all-around blacksmith in less than ten years, and many will never learn the trade.

The blacksmith must not only be a mechanic, but he should also be an artist. The work must be right in construction and beautiful in design. Then, when it comes to the working of highly carbonized steel, how few, how few, who know how to handle it without ruining it! Then, again, the simple-looking process of welding. There are smiths whose good welds are accidental. Now, why is it so? Because we have no system of learning the trade.

After three months' apprenticeship with a bungler, many a young man hangs out his "shingle" and advertises for work he never learned to do. The man who has not learned the elementary rules for a trade or a profession will never be efficient. On the other hand, the man who has learned these rules has learned the A, B, C, he is on the right path, and time and perseverance will bring him out right.

We visited the manual training school (slojd) in our city, not long ago, and when I left I felt sorry for both the scholars and taxpayers. These scholars imagine, now, that they are mechanics, since they are able to make a few articles; but I hold that this training will harm them through life. They were pegging away like a woodpecker, without system or order. The positions of their bodies and of the handling of the tools were awkward and unnatural. If an old carpenter had been called in as a teacher, he would soon have given them some instruction in this respect that would have been a help to them in after life.

It will be our aim, therefore, to present a book that will be a beginning to a better system, or, rather, a beginning to a system. We shall begin with a series of lessons, giv-

ing the elementary rules and steps necessary to successfully master the trade.

HORSESHOEING.

Horseshoeing is a distinct trade, but to most people blacksmithing and horseshoeing are synonymous terms. There are thousands of smiths who have never nailed on or made a horseshoe, and there are a great number of horseshoers who cannot be termed "smiths" in that sense of the word, for their knowledge of blacksmithing is limited to the fitting of horseshoes. Sometimes we find a blacksmith who is a fairly good shoer, but we shall never find a horseshoer who is a good blacksmith; but in the smaller towns and country shops the smith must practice both trades.

In no other trade has there been such a great confusion in the last decade as in the horseshoer's. Every horseshoer, with few exceptions, has his whim or hobby. They are mostly "one-idea men." The shoe is shaped a little different at the heel, and that is *it* to one man. Another believes in side-weight shoes, another toe-weight shoes, another bar shoes; and many have such faith in their fad that they can make any old nag compete with Dan Patch for championship of the world, and cure diseases of all kinds simply by shoeing with the right kind of shoes. From their talk, you are certain that they can subdue any disease, from glanders to corns. And I warn the horse owner against the toe-weight farrier, for he might put on such toe-weights in front that the front quarters of the horse might run away from the hind quarters.

To follow all these whims would require a large volume alone, and we assure the mechanic or apprentice who wishes to know the facts that we shall not be guilty of any

hobbyism of any kind, but give the rational ideas and facts. We do not believe in faith-cure shoeing.

WAGONMAKING.

Wagonmaking has also become an almost extinct trade outside of the large wagon factories; and we meet a very old man, when we meet one who has made wagons. This trade, or what is left of it, is also performed mostly by the farrier or the smith; and to tell the truth, the work is not always the best, for a jack of all trades is a failure. But when we have not the wagonmaker, and the work must be done, we must excuse the farrier or the smith for their shortcomings. In many cases, lack of knowledge is the cause of a poor piece of work. This volume will give the smith or farrier, as the case may be, information on such work, which is regarded as a trade secret with wagonmakers, and must be understood in order to make the wheels "go around." We shall begin with forging, and take up the different kinds of work that come within the scope of a modern blacksmith, horseshoer, and wagonmaker.

CHAPTER II.

"Now there was no smith found in all the land of Israel to make swords and spears."—*I Sam. 13, 19.*

Tools, and good tools, are the first essential to a mechanic's success. The tools should be suited to the work. It is no use trying to make a square hole with a round punch. The tools should also be kept in good condition and in their places. The aphorism, "A place for everything and everything in its place," is very appropriate in regard to tools. Neither should we forget "that a man is known by the company he keeps," and "a mechanic by the tools he uses."

Tools, now-a-days, are mostly bought. The smith even buys his tongs and chisels; but it is so in regard to almost everything that is used by the smith in his trade. It is ready made, and sold by the manufacturers. The result is that we have smiths who are not smiths.

I often meet young, unthinking smiths who boastingly ask: "What would the old-fashioned smith do if he could come back and had to do our work? He would not be in it, would he?" The old-time smith, if he could come back and see the manufactured tools, and all the articles he used to make by hand sold ready made to the smith, he would evidently exclaim: "How easy; no smithing about it. Just put it together; it is all ready made."

LESSON I.

The first thing for the amateur smith, as well as the apprentice, to learn, is how to use the tools; also how to

place them. Most of our blacksmith shops lack order. The forge and the anvil are so crowded together that it is almost impossible to get in edgewise between them. And in most cases the anvil is placed too high. The distance between the fire—not the forge—and the anvil should be from six to seven feet. The anvil should be just high enough to touch the knuckles of the smith's hand when it

Fig. 1. Correct Position.

is closed and the smith stands erect at the anvil. This will give the right height for all smiths.

The anvil block should be a square block, the size of the foot of the anvil, and not like the chopping block in a butcher shop, as we often find. Nothing can be more awkward than a large block with all kinds of tools on—the anvil in the center, and the smith stretching out in a half circle, trying to reach out far enough to reach the anvil.

When we see a mechanic with these arrangements, we know he is rated in the third class.

Correct position and composure of the body must be attained—First, for the ease it gives in performing the work second, it lends grace to the movements, which we should strive to gain, for it is very painful to look at an awkward mechanic, and such a workman will never succeed as well

Figure 2. Incorrect Position.

as the easy workman, whose movements are both correct and graceful.

In looking at Fig. 1, p. 7, you see a smith with free and easy position. Fig. 2 is the opposite to this. Here is a third-class man. Just mark his awkwardness. He presses his elbows against his rib. When you see a smith of this kind, you can rest assured he would not command a very high salary if he were to work for another, for he is a "bundle

carrier"; that is, he squeezes his arms against his sides as if he were afraid he would drop something. It is generally the case that he also turns his toes in, forming a triangle.

LESSON II.

THE SLEDGE.

The right use of the sledge is important. The helper should stand in front of the smith and anvil, and not to

Fig. 3. Correct Position.

one side. When we see a helper standing either at the butt or the horn-end of the anvil, we know that he has not received the first lesson in striking.

In Europe it is customary to hold the sledge so that the handle will be under the arm,—the right or left, as the case may be. In this position, it is impossible to strike hard or endure, for the helper must first put one arm

around to the other side, which is an unnatural position.

Let the apprentice take hold of the sledge handle in such a manner that the hind hand will hold at the extreme end of the handle, and the fore hand slide up and down as it best suits, to make the work easy. See Fig. 3. Another position must be taken in swinging the sledge. The ap-

Figure 4. Swinging the Sledge. Incorre ct Position.

prentice should take hold of the extreme end of the sledge with both hands, and let the sledge describe a perpendicular circle. After the sledge has struck the iron on the anvil, it should drop straight down to the floor. See Fig. 4A.

THE FIRE.

A poor smith makes a poor fire, and a poor fire makes a poor weld, and a poor weld makes a poor job. It is a

fact that very few smiths have learned the art of making a good fire. First clean out all clinkers and cinders; then take some shavings and set them on fire; let them burn well down; then take a handful of dry, small green or fresh coal, and sprinkle this on top of the almost burned-down shavings; now start the blast, but blow lightly, as a strong blast would blow out the fire; now add some coke, and, on top of that, wet coal; then pack them tightly to-

Figure 4A. Correct Swinging.

gether. This will make the coal solid, and prevent the fire from spreading. Another way is to place a wooden block the size of the fire wanted on the tuyer, and pack around it wet coal; then pull out the block, and start the fire in this hole. If the flame is of a yellow color, look out, for then the fire is not fit for welding. If the fire smells

of sulphur, it is also a poor fire. When the fire spreads out too wide, and you notice a lot of fine coal dust or grains in the fire, it is also a poor fire. Do not let the fire grow hollow or empty, for the wind will then blow directly on the iron, causing it to scale. This is termed

Buffalo Blower. No. 200.

"oxidizing fire." Too much wind will in every case produce an oxidizing fire. When the blast or air comes in contact with hot iron, it forms oxide or scales. Much

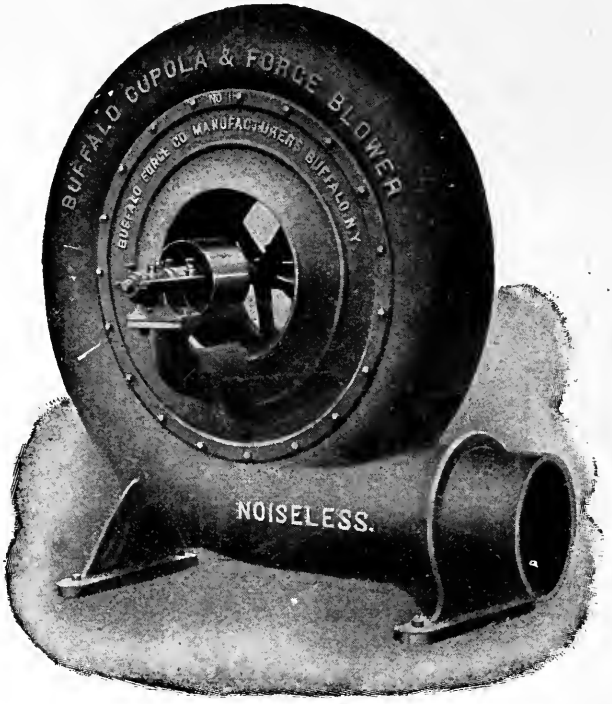
oxide makes a rough surface, and prevents fusing. Make the fire large enough. Many smiths are too saving with the coal. The iron to be heated is almost in touch with the tuyer. The result is that it will not heat, but produce scales. Let the fire be so deep that the iron to be heated rests from three to eight inches from the tuyer, with plenty of coke between. If the fire has a tendency to spread and grow large, it is because the coals are in large pieces or poorly packed. In either case, pack the fire and keep it

Figure 5A.

wet by sprinkling water around it. Good coal, of course, is another requisite for a good fire. Good blast is also essential. Buffalo Forge Co., Buffalo, N. Y., makes the best blowers, as well as many other tools and machines which I shall mention later.

I used to think that the old-fashioned bellows could not be beat for blast, because many of the so-called blowers

failed to be what was promised from them, but we now have a blower that blows, and does it easy. Every smith who needs a hand blower should have a "Buffalo Hand Blower No. 200." This is the easiest blower I know of. I cheerfully recommend it to every smith. I don't know how many bellows the different apprentices in my employ exploded, but it was quite a number. The "Buffalo Blow-



Noiseless.

er" is "fool proof"; it can't be exploded. Ask your dealer for it.

In Fig. 5A, a modern steel plate forge and blower, the Buffalo, is shown. This forge is portable; can be placed

wherever wanted in a shop. It is reasonably cheap, and an ornament to any shop. For power, and where the

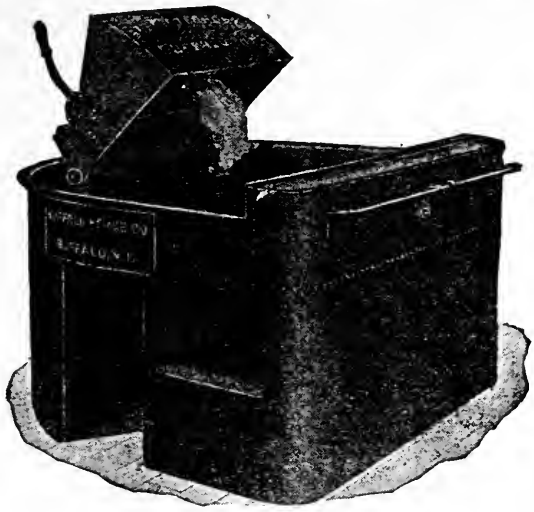


Figure 5C.

blast is to supply several forges, the "Buffalo Steel Pressure Blower, Noiseless," should be used.

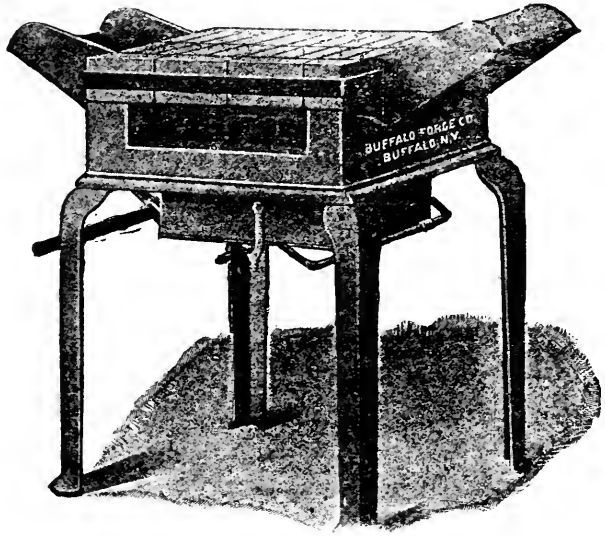


Figure 5D.

Fig. 5C is the latest invention in down-draft forges. In these forges the smoke is sucked down by the draft, and

chimneys are done away with. Fig. 5D is another forge or furnace for heavy work under steam hammers, or when many pieces at a time are to be heated.

LESSON III.

IRON.

Iron is the most useful of the metallic elements. Metallic iron in a more or less pure condition is occasionally found in nature, but this supply is very small. As Tubal Cain was an instructor in working iron, we can surmise that this metal was known before his time, and it is almost certain that Cain knew of it when he invented weights and measures in the first city of which he was the founder. The iron thus used or worked was of the kind just mentioned. The period when iron was first extracted from its ore is not known, but we know that it was known in the remotest time of the history of man, from the tools and weapons found. The earliest method of extracting iron from its ore consisted in placing lumps of ore in a fire of wood or charcoal, and, after a more or less complete reduction, the spongy metal thus formed was hammered and shaped.

The Assyrians used iron very much. Saws, knives, and other tools have been found at Nineveh. Many of these tools are much like tools of the present day. Homer refers to the forging of iron. That a crude bellows was used in the forging of iron is proved by the figures in Egyptian sculpture of more than 1500 years B. C. Pliny, about 50 A. D., describes the making of iron and steel. That they had then been experimenting in the art of tempering is evident from the fact that he claims that the re-

sult of the tempering of steel is dependent on the nature of the water used, and he explains that oil in some cases was better than water.

The best iron is manufactured in Sweden. There is found good ore, and charcoal is used in the extraction of the iron from the ore; therefore Swedish iron is the best, and makes the best steel. We have, in spite of the great improvements, still a very poor grade of iron in this country. We have "cold-short" and "hot-short" iron. Sulphur in the iron when hot makes it brittle, and phosphorus makes it brittle when cold. This explains the cause for some iron breaking when we try to form a link of hot iron, while the same iron will not break if bent cold, and vice versa.

LESSON IV.

STEEL.

There are many kinds of steel, but to the general blacksmith only two kinds are known,—"mild steel" and "tool steel." The mild steel is fast taking the place of iron. In some instances it is cheaper, and it is certainly giving better results than iron. The mild steel is easily worked and welded, as it stands a higher heat than the harder steel. Sand is the only welding compound needed to weld mild steel.

The finer steel must be handled with great care, and few are the smiths who know how to heat highly carbonized steel. We often hear the remark, when a tool breaks, "He didn't harden it right." No hardening will prevail in an overheated tool, and the hardening and tempering of a tool is comparatively easy when the steel has not been overheated. The trouble begins when the smith places the steel in the fire. If it is a thin edge, the danger is

greater than in a heavier piece. There is danger of overheating the outside edges before the center part is hot enough to work. High grade steel is also ruined by keeping it long in the fire at a high heat; thus the fiber of the steel is ruined and the carbon burned out. The higher the percentage of carbon, the more difficult is it to weld, and that for two reasons: First, such steel cannot be heated to a high heat; and second, there is less fusing material—slag and cinders—in this kind of steel, hence it is often necessary to use some kind of welding compound in welding it. Good steel breaks easily when cold, if cut into a little. It will also crumble under the hammer when white hot.

If the broken ends of a steel bar are of a fine grain and light color, the steel is good. Glistening and glittering coarse grains are a sign of poor steel. Alloy steel is used for crushing machinery, and for armor plate, and also for machinery where the friction is high. For alloy is used chromium, manganese, and tungsten.

ANNEALING.

Highly carbonized steel is often found too hard to file or drill without annealing. To reduce brittleness and increase flexibility, annealing must be resorted to. The simplest, yet most effective, method is to heat the steel slowly until red hot, then bury it in the cinders, and let it cool slowly. If a piece of fine steel is heated and exposed to the air in cooling, it will cool too fast, especially in cold weather, and contract what is termed "air temper."

Cast iron is sometimes found to be too hard to drill before it is annealed; then a different method of annealing must be used. Heat to a low, red heat. Place a piece of

brimstone just where the hole is to be; this will soften the iron if it is left to cool slowly, as in annealing steel.

WELDING CAST IRON.

I don't believe I have met a blacksmith yet who could not weld cast iron, but I shall never meet the man who really *can* do it. There is no such thing as welding cast iron, and I offered $25 for a recipe to weld cast iron, in my book "Modern Blacksmithing," but so far I have had no response. Cast iron will melt and crumble before a welding heat is attained. It might, however, be melted together; but if such a thing could be done, it would generally leave the casting so melted together shorter, and consequently leave it in a different shape, and then it would be of no value. When a smith tells you he welds cast iron, you need not say he is lying, for he has evidently succeeded in "sticking" a piece of malleable iron together, and imagined it was cast iron. The wish, in such a case, then, was the father of the thought. Fine malleable steel is sometimes a very good article, and can easily be welded.

LESSON V.

HARDENING.

We shall begin the experiment in hardening with the simplest tool,—a chisel. We suppose you must dress the chisel first; then be careful, for the trouble begins with tool steel the moment you place it in the fire. Now place the chisel in the fire, far in, so the extreme edge will reach over the hottest place in the fire,—that is, the center,—otherwise you are liable to burn the edge, as it is thin, and is liable to be too hot before the rest of the chisel is hot enough; and if the edge is heated to a white heat, you better cut it off, for it matters little how you temper it, if

it is overheated. Steel for edge tools should not be hammered much on the edge, as this hammering is liable to crush the fiber. When the chisel is dressed, and you are ready to harden, proceed as follows: Place it in the fire and heat slowly. When it is of a dark red heat on a bright day, it is hot enough. In the dark this heat will look many degrees hotter. This you should always remember in hardening of all kinds. The temperature of the water should be taken into consideration. If the water is ice cold, the heat should be lower, and vice versa. For hardening of all edge tools, water is the best. When your chisel is of the right heat, stick it into the water an inch, or in proportion to the range of the heat and of the tool. When cool enough, take it out, and rub it with an emery cloth or a piece of a grindstone, or anything that will brighten it so that you can easily discern the color as the temper is drawing.

For a cold chisel, let the temper go back until it turns blue; but here be quick, for as soon as it is blue, stick it in the water. A moment's delay will make it too soft.

For a "hot cutting" chisel, the temper may be a little harder. This blue temper is right for all cutting tools. If you dip the tool in the water just when the blue color reaches the edge, and then pull it out while it is yet sizzling, you will notice, while it is yet wet, a copper color under the water at the extreme edge. Then you will know it is plenty hard for even wood-cutting tools, if you have the right kind of steel.

BRAZING.

In brazing anything, the joints should be filed clean, and fitted snugly together; then have the brass, in thin pieces, placed over the joint; then a little borax on top.

The article should then be placed in a clean fire, the heat striking directly over the joint. When the brass is melted, take it out of the fire and cool off.

CHAPTER III.

"A bad workman quarrels with his tools."

LESSON VI.

FORGING.

"Strike while the iron is hot," is an old and well-known proverb; but I have coined a new maxim, "Strike till the iron gets hot." It is true that, in forging, we can do little with cold iron, but with smaller articles we can pound the heat into them. Take a piece of Swede iron or mild steel,—a quarter-inch rod, for instance,—and point it out fast over the edge of the anvil, and if the rod is ice cold in the start, it will take but a few seconds before it is of a high red heat. The spectacle is worth the trouble.

The first step in forging should be to point a rod over the edge of the anvil. It takes a good smith to be able to point a rod of American iron without splitting the iron into a brush shape on the point. When you have pointed the rod, you will find that the sides—for it should be a square point—are not square; and why are they not? For two reasons; you have not turned the iron to the right angle, or you have not held the hammer to the right angle. I advise all new beginners to practice until they can hammer out a square point with right angles. When you have learned to sharpen or point a piece of quite poor iron without splitting the point, then you will also be able to hammer the red heat into a piece of mild steel or Swede iron. In pointing or sharpening anything, hold the hand with the rod a good deal higher than the anvil, and let the

end of the iron rest on the outer edge of the anvil. See Fig. 7.

MAKING RINGS AND LINKS.

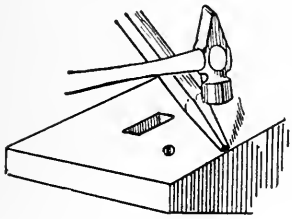


Figure 7.

Bend the iron to a U-shaped piece. Both ends should be of the same length. Then place on the anvil, and scarf the ends, as shown in Fig. 8. You will note how the ends are scarfed with the flat cross pene of the hammer. When a round pene hammer is used, the link or ring has to be placed over the edge of the anvil, in order to scarf the ends; but this is more troublesome, and, for that matter, a round pene hammer is more of an ornament than of practical value to a smith. Still, you can't convince a smith who is fascinated with the round pene hammer until you put him alongside of another smith where different kinds of repair work is done, and he finds that he is not "in it" to turn the work out fast. The round pene is of very little value anyway. It is supposed to be for riveting purposes, but even for that the face end of a hammer is better; for if the rivet is of common iron, the round pene will split the rivet, and it will crumble, while the face of the hammer will keep it together. The flat pene hammer is the hammer for the smith. The trouble with the hammers used by most smiths is that they are made too short, and with a too wide face, which takes too much friction going through the air; and where the face is wide and level, the corners only will hit, and mar the work with dents.

The hammer should be high, the face not too large and a little rolling-convex. Place the link or ring on the anvil

and scarf as shown in Fig. 8. When one end has been scarfed, turn the link over, and scarf the other end, and the scarfs will then be on opposite sides, which makes a snug fit when lapped over each other. Now turn the link over the horn, and weld. In making chains, two links are welded separately and the third will be welded in between, and link them together. Links, rings, and washers are made on the same principle.

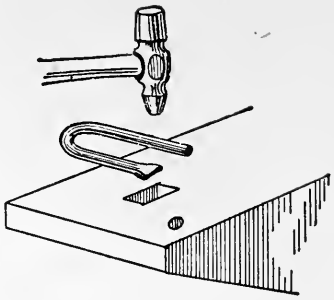


Figure 8.

LESSON VII.

WELDING.

Wrought iron and steel will fuse when the proper temperature and the right quality of the temperature is attained. We often read in the trade journals and in books, "Iron or steel will weld when hot enough;" but the metal may be hot enough, be of the proper heat, and still it will refuse to fuse. Then there must be something besides the degree of heat to consider, and that is the ingredients or quality of the heat. Such as the fire is, such the heat. If the fire is full of small cinders and sulphur, you try any degree of heat you wish, and there will be no weld; and if, perchance, you will be able to make it "stick," it will be a poor weld, that will break at the first strain. Iron as well as steel will burn, and if overheated will make a poor weld. The heat at which iron will weld is the melting heat. When the scales which are formed on the iron melts, the pieces will stick together. But the scales or oxide may not melt even at a high heat. For instance, if the iron is held too close to the tuyer, and the blast strikes directly

on the iron, or the coal or coke may have burned out, so you have a hollow fire, then the air will also strike the iron and form black scales, preventing the scales from melting. Too much blast may be the cause in some instances. A trained eye will tell at a glance whether the fire is a fire for welding or not. If the iron is burnt, there will be a lot of sizzling sparks issuing from it, and the surface is rough and dry. In this kind of a heat there is no fusing quality. Sand is the best welding flux for iron. It will form a glue-like coating, and promote the dissolution of the oxide. If the parts—iron or steel—that are to be welded together be of a large dimension, it is best to heat slowly, for otherwise the outside might be too hot while the center is still too cold. This lower temperature in the center will chill the outside when the iron is placed on the anvil, and thus spoil the weld.

Not only in welding, but for all kinds of forging, it is important to have all tools in their proper places, and the apprentice should be taught to be careful not to take any tools away from the forge's tool bench. This often happens in a repair shop, and it is very annoying to have taken much pains in producing a good weld, and then, when you place it on the anvil, you find that the hammer has been used by some one and left somewhere in the shop.

Steel of a high per cent. of carbon is more difficult to weld than iron or mild steel. If fine steel is heated until the sparks appear, it is ruined and the best thing to do is to cut the burnt part off. Highly carbonized steel cannot be welded without a flux, because it cannot be heated to a heat to melt the scales without burning, if no fluid is used. In welding steel, beware of the oxidizing fire. That does not necessarily mean too much blast; it may mean too little blast, or it may mean a hollow, dirty fire also. Borax is

the most used flux for welding fine steel. It has two offices: First, to help melt the scales; second, it prevents burning and oxidizing, by covering the steel with a glue-like coating. This coating keeps the air from coming in contact with the steel, and thus much mischief is prevented. The flux does not act as a glue; it promotes the melting of the oxide. And although an oxidizing fire is a bad fire, there could be no weld without it, for this oxide is simply a thin coat of iron; and when this iron is melted, that, and that alone, is the cement that has the power to unite the two pieces, as it is "flesh of the same flesh."

Steel borings are often used in welding steel. If these borings can be placed between, it will aid materially in making the two pieces stick, as it will not slip so easily when these chips gripe in the steel. All kinds of welding would be easy if we could find coal free from sulphur.

LESSON VIII.

THE DIFFERENT KINDS OF WELDS.

There are seven kinds of welds, and we shall now consider each kind separately.

Fagot-Welding.

Fagot-welding was much practiced by the smith in times past. When one piece of iron is not large enough for the work, two or more pieces are laid on top of each-other and welded together. Sometimes many small pieces are put up in a bundle, and held together with wire. It was claimed by the old-time gunsmith that a gun barrel made from old horse shoes, or, better yet, from old horse nails, would make the best gun. In such a case, these pieces were fagot-welded. We do very little of that kind

of welding now. If the size we have on hand is not large enough, we send for the right dimension.

Lap-Weld.

The lap-weld is the most used, and it is also the easiest and the strongest weld, if it is properly done.

The first thing to do in preparing for a lap-weld is to upset the ends to be lap-welded. The upsetting can be done in different ways,—either by hammering the stock back, in preparing the lap (see Fig. 9), or by butting the end of the iron against the anvil. The material should be a good deal heavier over and behind the lap before it is welded than what it is to be when welded. If the pieces are simply scarfed without upsetting, it will make a weak weld, and a meager looking weld; for the stock will then be smaller over the weld than in the rest of the bar, and that is just the kind of welds every new beginner makes. It is always the safest to have plenty of stock for the lap; for if it is, the weld can be forged down so that it is impossible to detect the place of the weld. This can be done only where there is material enough.

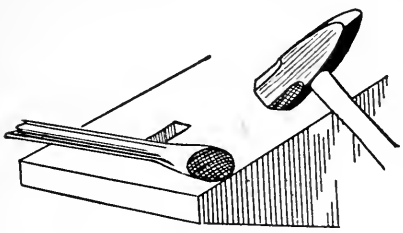


Figure 9.

The scarf should be made convex, not concave; if the scarf is concave, there will be scales or cinders and air in the pocket formed, and there will never be a solid, strong weld. See Fig. 10.

In placing the iron on the anvil for the weld, let the apprentice hold his piece so that the extreme end does not come in contact with the anvil, and the smith should rest his piece over the opposite corner of the anvil, so as to

guide it in placing his piece in position over the other; for it is not so easy to place this piece right, and if it is not placed right, and let down on the other, where it is liable to stick, it will be almost impossible to get it loose and replace it before the weld is too cold. See Fig. 10.

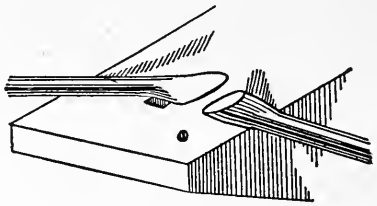


Figure 10.

This lap or scarf is all right for iron, but for mild or harder steel another scarf is sometimes better, for it is more sure to grip. See Fig. 11.

Figure 11.

It is difficult to teach how to find the proper welding heat in any other way than by an object lesson, and then the apprentice must be humiliated by many failures before he is able to make a good weld.

In all lap-welds the ends must be scarfed,—that is, pointed to a sharp edge,—in order to get a strong weld. In cheap blacksmithing and such light work as hub rings, etc., the weld is often taken without the scarfing; but in every case when this is done you will find that the square ends will cut into the stock, and weaken the weld considerably. You may be able to do cheap work that way, but not good work.

Butt-Weld.

The butt-weld, although not the strongest, is often a very convenient weld. In this weld, the pieces are butted together without scarfing. It comes handiest in heavy round material, and the ends are rounded, as shown

in Fig. 12. If the ends are convex when welded, the weld will start in the center, and force any foreign matter out. On the other hand, if the ends are concave, it will form a pocket where cinders, scales, and gas will form, and a good strong weld is then impossible.

Figure 12.

If the bars are long enough, the weld is most easily taken in the fire; that is, it is started while the bars are in the fire. The helper holds one end with a sledge up against the end of the bar, while the smith holds the other end from the opposite side of the forge, and strikes with a heavy hammer on the end. When the weld is sufficiently forced together, the bar is taken out and placed on the anvil, where it is forged down and smoothed up. In a butt-weld there is a deep seam where the ends meet, and the ends must be upset so much in welding that there will be material enough to work down on and smooth the weld. If the pieces are short, they must be welded out of the fire, standing the ends in an upright position.

Jump-Weld.

The jump-weld is simply another form of the butt-weld. This weld should not be resorted to by any but an experienced smith, for it is a very difficult weld to make, and, if not properly made, will prove of little value. The bar welded to a flat or wider piece should be upset till it flares out in a flange-like shape; and the wider the flange or foot, the better. When both pieces have the proper heat, strike on the end of the bar a few blows; then finish up with the fuller,—not the set hammer as some third-class smiths do; for the set hammer has sharp corners, and will

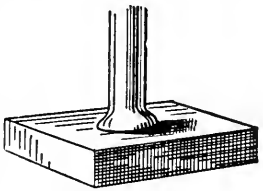


Figure 13.

spoil both the looks and the strength if it is used here. Let me say in this connection that the set hammer should be used sparingly in all forging. The fuller is in most cases the better tool.

T-Weld.

T-weld is another form of the butt-weld, and is also a difficult weld, comparatively. Still this weld is easily mastered. When the T is to be from flat iron, scarf the bar on the edge where the weld is to be, and the other bar is to be scarfed on the end. This is the weld used on

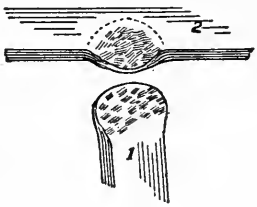


Figure 14.

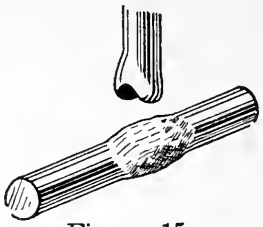


Figure 15.

our "fill iron." See Fig. 14. If the T is to be made of round or square material, scarf and prepare as in Fig. 15. In Fig. 14, No. 1 is placed on top of No. 2 as far as the dotted lines indicate. In Fig. 15 the one end is grooved over the horn of the anvil, and the other is upset over the point where the T is to be welded.

Split-Weld.

In thin stock, it is often difficult for a less clever welder to weld the pieces together, and in such a case a split weld, like Fig. 16, can be made. This is the weld all third-rate smiths use in welding tire, but no experienced tire welder will ever

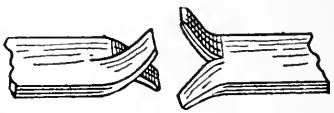


Figure 16.

resort to such a method. For heavy stock, especially in highly carbonized steel, a split weld is the best. In preparing the iron or steel bars to be welded by this method, proceed as follows: First upset the pointed end, and prepare as is shown in Fig. 17. You will notice some notches in the scarfed point. Then cool this piece off. Next prepare the split end by upsetting, either before it is split or after, by fullering it in the fork. Now heat the forked end quite hot, but leave the pointed end cold. By so doing, the cold prongs in the pointed end will penetrate into the hot ends of the forked end, and hook the pieces together, so that it can be handled in any shape or manner, and they will not come apart. In closing up the fork, have the helper strike hard blows with a twelve pounder. If there should be any crevices at the point of the inside end, as there is liable to be, make a wedge and drive it in to fill this hole; for if any little crack is left open, cinders are liable to be blown in between, and spoil the weld. Next prepare to weld. Have a clean and large enough fire, and heat slowly, for the inner piece will not heat so fast as the outside. If steel, be careful not to burn the outside lips. Have a light hammer with a long handle to "stick" the lips in the fire with; that is, the thin ends of the forked end should be welded while the piece is yet in the fire. Then place on the anvil, and let one or two helpers come down on it with a heavy sledge.

Figure 17.

Angle-Weld.

Angle-weld is one of the easiest welds to make. Simply pene out the corners as shown in A in Fig. 18. The leg B should be pened out the same way. Place A on top

of B, and weld. When a piece of angle iron is wanted this is the quickest and strongest way to make one.

Circles.

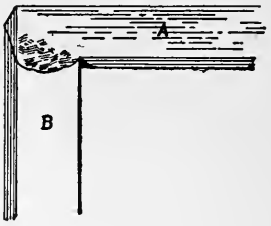


Figure 18.

Suppose a band is wanted around a round object, the diameter being six inches, and the stock to be half an inch thick. To find the length required to bend anything when the stock is not over one-half inch thick in the band, multiply the diameter by 3, and add three thicknesses of iron which is taken up in bending and one thickness for the weld. That is, to band an object six inches in diameter with half-inch thick iron,

6 times 3 is.....18
Four thicknesses of iron 2

20 inches

In bending a band, it will be observed that the inner side of the curve is shortened or upset, while the outer side is stretched and is consequently a little longer.

CHAPTER IV.

"The eye of the master does more work than both his hands."

LESSON IX.

The making of horse nails is a good exercise while learning the elementary steps in forging. Get a nail rod 3/16x1/2 inch Swedish iron or mild steel. Point the rod, or draw out the nail to the length desired. Then place the rod edgewise on the anvil, with the rod over the inside edge of the anvil. Now strike with the hammer in such a manner that the face of the hammer, with its center, hits over the edge of the anvil, thus making a shoulder for the head. See A, Fig. 19. Then place the nail over the hardie where the dotted line indicates, and cut off. B, Fig. 19, is another kind of nail, called the "calk nail." This nail is made in the same manner as nail A, and when the head is forged the nail is placed on the anvil as shown in Fig. 20, and the point bent back. When this nail is cut off as indicated by the dotted line in Fig. 19, it will make a diamond shaped head, which will act as a calk. When the calks on the shoe get dull, a couple of nails can be pulled out, and a few of these calk nails driven in, and the horse is sharp-shod again.

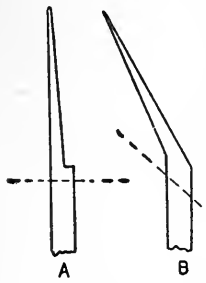


Figure 19.

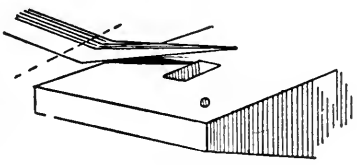


Figure 20.

CHISELS.

Take a 1¼-inch square bar of tool steel,—not mild

steel,—and punch a hole three inches from the end. The punch for the punching of the hole should be made of 1¼x ½ tool steel, pointed to the size of ¾x⅜ on the end. In punching the bar, you will find that the punch is liable to upset and stick in the steel. To prevent this, place a little cinder or a coal the size of a bean in the hole, and the punch will not stick. When the punch has penetrated far enough to make a mark on the opposite side, turn the steel over, and punch from that side. This done, put the bottom fuller in the hole of the anvil, and place the steel over, so that the inside of the fuller is about half an inch from the bottom side of the hole in the chisel, and the top fuller right over it. Now make a groove all around, as shown in Fig. 21. This done, draw out as indicated by the lines, to make a hot chisel. For a cold chisel, let that be a little heavier all through from the edge down. Next cut off and draw the head down a little, as indicated by dotted lines. Harden and draw the temper to a blue hue for cold chisel, and with a shade of coffee color for a hot chisel.

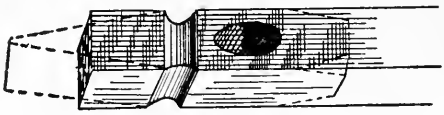
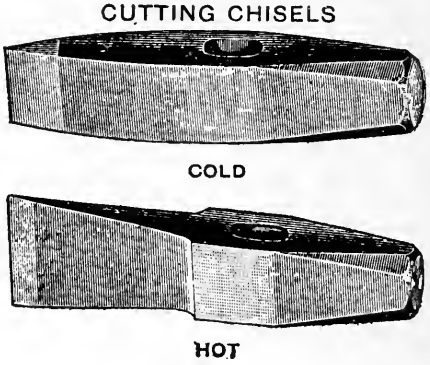


Figure 21. Chisel.



CROSS-PENE HAMMER.

In making hammers and punches, we start by making the eye. First punch with a punch ⅜x1¼, tapered to about ⅜x⅞ after the hole is started. Have an oval punch the size of the hole. Drive this into the middle of the

punch. Then fuller out as shown in No. 1, Fig. 22. Next place the eye of the hammer made over the bottom fuller, with the top fuller on the top side, and fuller out as shown in No. 2, Fig. 22. This leaves the forging like No. 3 after the eye is rounded off. Now, if you want the hammer round over the eye, place the punch in the eye when the hammer is hot, and upset against the anvil; then smooth off with a small flat hammer,—not the set ham-

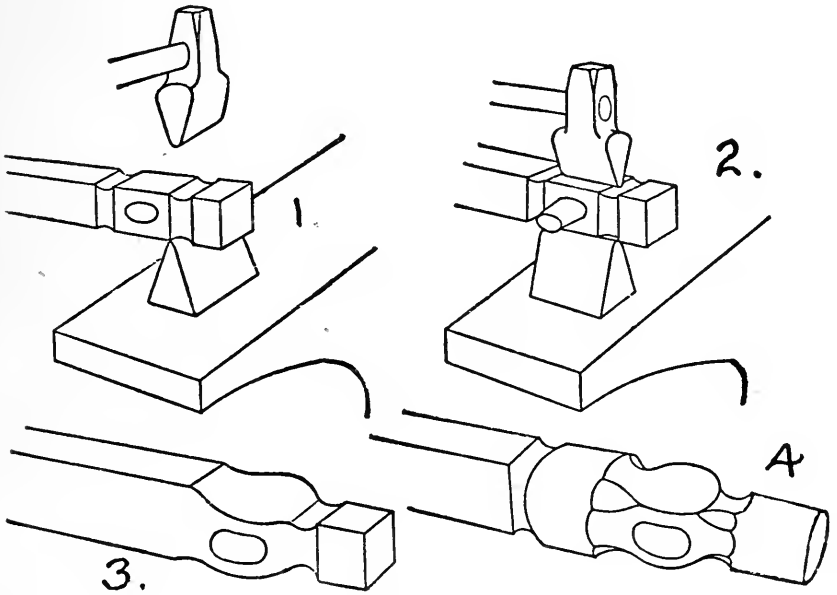


Figure 22.

mer, as new beginners do. The set hammer has a square face and corners, and is not fit to use in forging. Next draw out the pene as shown in No. 4, and round up the face. When finished, harden the face end first to a yellow straw color, about to shift to a coffee color. The pene should be drawn to a blue color. In heating the pene, place a wet rag around the face end of the hammer, if you think it is hot enough to draw the temper.

FLATTER.

In making flatters, upset the end of the steel until it is flared out to the size wanted. The material for the flatter must be not less than two and one-half inches square tool steel, and the face should be from three to four inches, according to the size wanted. After the end has been upset, place the bar on the anvil, face of the flatter against the anvil, one side resting against the bottom fuller, so that it cannot slide off the anvil, and then use the fuller—not the set hammer—to shape the flanged face. See Fig. 23.

I cannot too often warn against the use of the set hammer. It is a tool too much used where it should not be.

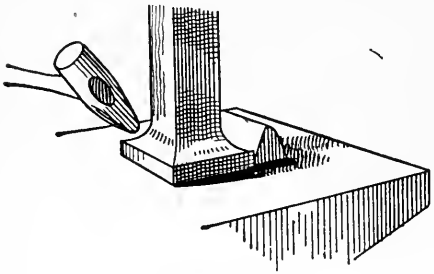


Figure 23.

Some smiths will take the flatter at this stage in the making, and place the bar in the square hole in the swage block, and strike on the face end with the sledge. In so doing, you will forge a sharp cut into the steel, and make the foot a square angle. This is neither a strong nor a good-looking flatter. When the flatter is finished, it should be like Fig. 24. The flatter should not be hardened, nor the head of any tools like chisels, set hammers, flatters, and any tool on which we strike.

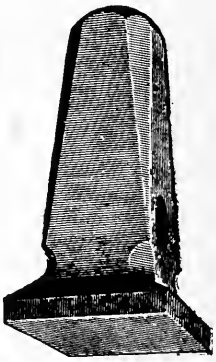


Figure 24.

SWAGE BLOCK.

The swage block is a very handy tool, and every smith should have one, for it answers for swages and head tools both. See Fig. 25.

LESSON X.

SET HAMMER.

The set hammer is one of the easiest tools made. Take a piece of tool steel 1½ square inches. Punch the hole

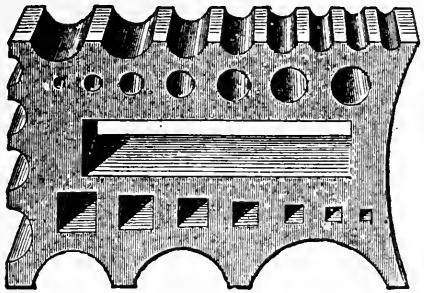


Figure 25.

SET HAMMER
Figure 26.

as when making chisels. Place the set hammer over the bottom fuller cornerwise, the top fuller on the upper edge. Have the helper strike a blow or two, and the grooves thus made will make the set hammer look nobby also. See Fig. 26. When the hammer is ready, harden and draw temper to a coffee color.

SWAGES.

For bottom swages, use tool steel 2 inches square. Place the steel over the fuller, and fuller down to the size of the square hole in anvil. Draw out that shank to go in the hole first. Next cut off steel, heat, and place in the hole in anvil, and draw out. The rest suggests itself. When ready to groove, place a piece of iron the size wanted over the part to be grooved, and strike with sledge. You may place the flatter on top of the rod to hold it steady. Top fullers are made much the same way,—the

hole to be made when the rest is finished, contrary to the rules for hammers, etc.

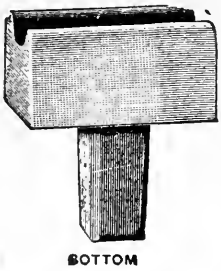
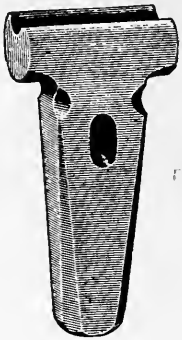


Figure 27.



Top.
Figure 28.

FULLERS.

Fullers are made the same way as swages. See Figs. 29 and 30.

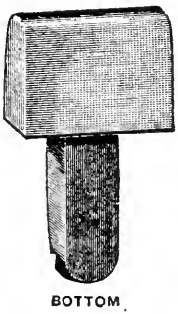
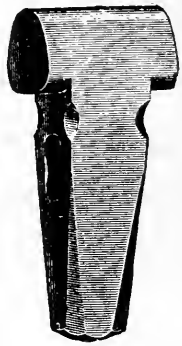
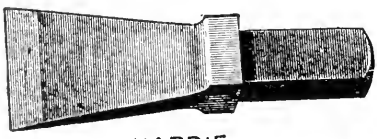


Figure 29.



Top.
Figure 30.

HARDIE.



HARDIE
Figure 31.

Hardies are made on the same principle as bottom fullers. They must be made of good steel, and hardened. Draw the temper until it turns from coffee to a blue hue color. See Fig. 31.

BLACKSMITH PUNCHES.

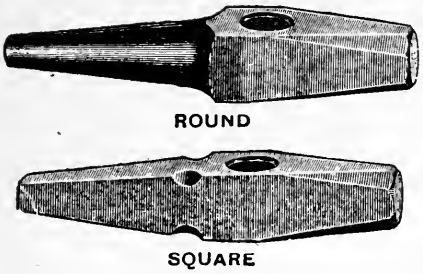
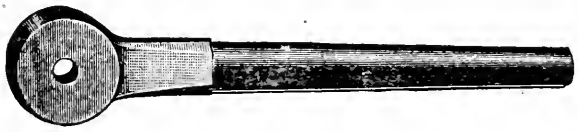


Figure 32.

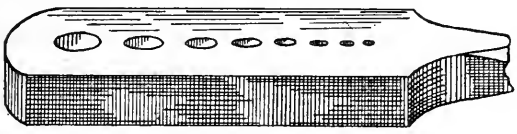
Punches should be made of the best tool steel. Use 1¼ or 1½ inch square material. Punch the eye first; then make a groove under the eye with the fuller; next draw point. These tools are easily made. Do not harden. See Fig. 32.

HEADING TOOLS.

For bolt making, a heading tool must be used. To make one, take tool steel 2 inches square, fuller off the head, and draw out shank, as shown in A, Fig. 33. Another yet handier head tool for a repair shop is shown in B, Fig. 33. This tool can easily be made from 1x2 inch tool steel. Drill the holes for the different sizes, and countersink one side for countersunk heads as for plow bolts, etc. Do not harden.



A. Figure 33.



B. Figure 33.

LESSON XI.

SQUARE ANGLES.

In making square angles, all new beginners and all third-rate men bend in the vise, but as a rule the wise smith is not much of a smith. If the piece to be bent is common American iron, it makes a very poor job to bend in the vise, for this reason: that the sharp corner

of the jaw will make a very sharp angle, and is liable to break under a heavy strain. It is important that no work be bent in the vise, especially if poor iron. Bend the material over the anvil. The helper holds the sledge as shown in Fig. 34. When the piece is bent, work it down to square on the inside by striking on the outside, while the iron is so held that it does not rest with the corner against the anvil. The angle cannot be worked to a square corner on the outside unless the material was heavier over the bend. This is a piece of work to do that must be done right, or it will neither look good nor will it be strong. If an attempt is made to work the angle until it is square on both sides, there will be a deep crack in the square on the inner side, and this will render the work useless. See Fig. 35A.

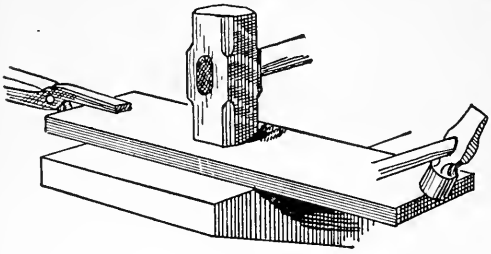


Figure 34.

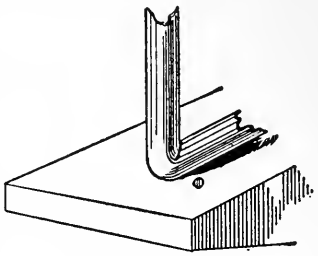


Figure 35A.

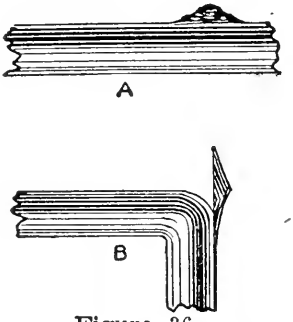


Figure 36.

If a square angle on both sides is desired, there are two ways of working: First, to upset the iron on the bend (See A, Fig. 36); but as this cannot be done in all cases, another and a very easy method to pursue is to bend the angle, and work it square on the inside; then make a wedge, and cut in for it in

the stock next to the corner; weld this wedge in and work it out to a square. The wedge should be tapered at both ends. See Fig. 36B.

LESSON XII.

TONGS.

Even blacksmiths' tongs are now manufactured and sold to the smith, but all older smiths prefer to make their own tongs. Every apprentice should experiment some in making tongs, for it is a good exercise in learning the trade.

To make a small pair of tongs, take ¾-inch square Swede iron. Place the bar diagonally over the anvil, with the end sticking outside the outer edge of the anvil about two inches, and strike with the hammer in such a manner that the center of the hammer comes down over the edge of the anvil. This will make the edge of the anvil cut

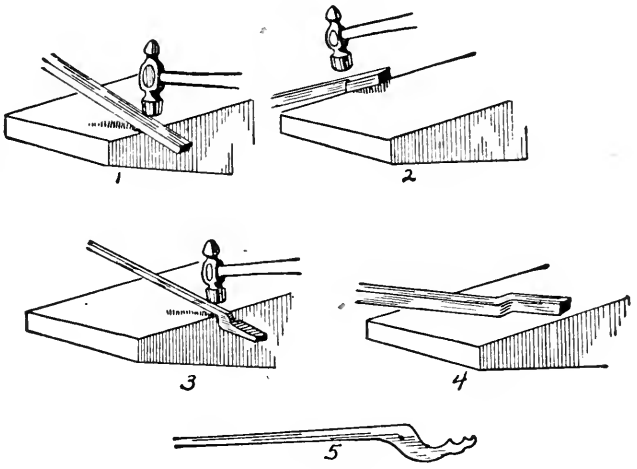


Figure 36A.

into the bar, and forge the first shoulder, as shown in 1, Fig. 36A. The next move, place the bar on the inner side of the anvil up against the shoulder made in the

first move, but the inside, that was down in the first step, must now be on the left side of the iron. Then strike in the same manner, and the edge of the anvil will make another shoulder. See 2, Fig. 36A. Next put the iron back over the outer side of the anvil,—the side that was down in the second step must now be up,—and then strike as before. See 3, Fig. 36A. This makes three steps, and they can easily be made in one heat, when one gets used to it.

If a pair of tongs with big jaws is wanted, bend the iron first as shown in No. 4, Fig. 36A, and then proceed as before. Both jaws should be made alike; for when they are put together, one is turned down and the other up, so you must therefore make them alike. They should also be made as described for right-hand tongs. By a right-hand tongs is generally meant a tongs to be held in the left hand, and when held in the left hand the lower shank is on the side next to the body; left-handed tongs the reverse. The jaws in a pair of tongs should be grooved, for they will hold better if they are. The groove can be made by placing a piece of round iron in the jaw while the jaw is hot; and strike so that the round iron will imbed itself in the jaw. Thus a groove of the size in proportion to the tongs can be made. This groove will give a better grip to the tongs, and it will hold round iron solid, which is difficult with a pair of tongs with smooth jaws. When one hole for the rivet has been punched, place that jaw on top of the other, and mark the hole. When the holes are both punched, cool the tongs off, and put in a hot rivet. You will now find that the tongs are rigid and cannot be opened; and to explain the next step, nothing can be said that will explain it better than to tell a good little story of an apprentice in

the good old times when the guilds held the sway: The apprentice had the tongs made and riveted, and found to his horror that they could not be moved. He then stuck them under the bellows, for he didn't want his master to know that he was puzzled. At the supper table, the apprentice told the story he had heard about an apprentice who, when he had made a pair of tongs, threw them away because he could not move the jaws after they were riveted together. "Oh, such a fool," said the smith; "why didn't he heat them." The next time our apprentice was alone he pulled out his tongs, made them red hot, and they could be worked easily.

S-Wrench.

S-wrenches are the most convenient wrenches in a shop. To make one, take a bar of tool steel ½ or ¾ inch. Place the bar edgewise over the bottom fuller, and the top fuller on the top side. Have the helper strike while the shoulders are made. Next draw out the stock toward the center of the material. See A, Fig. 37. The next step is to round the end up over the edge of the anvil. Then punch a little hole in the bottom of the jaw, and cut out with the chisel, as shown in B, Fig. 37. If there is enough stock, you may cut out as indicated by the dotted line. Then finish as shown by C. This makes one end of the S-wrench. The other end is bent in the opposite direction, and the jaw should be of a different size. These are the best wrenches. Do not harden.

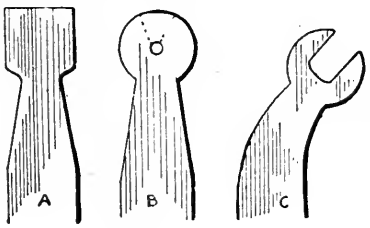


Figure 37.

Split Forging.

There is a great variety of work where split forging is

necessary. For instance, you wish to make a hole 1¼ inches round in a flat bar, when the bar is only 1¼ inches wide. In such a case, split the bar as shown in A, Fig. 38;

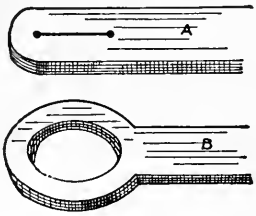


Figure 38.

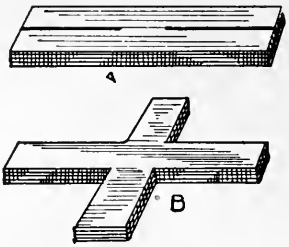


Figure 39.

then drive in a punch that will swell it out as shown in B, Fig. 38. It is safest to first punch a little hole at each end of the split, for otherwise the split may keep on split-

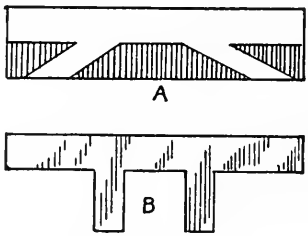


Figure 40.

ting further than is wanted. This is especially the case when the material is American iron. Fig. 39 shows another kind of split work. If a cross-shaped piece is want-

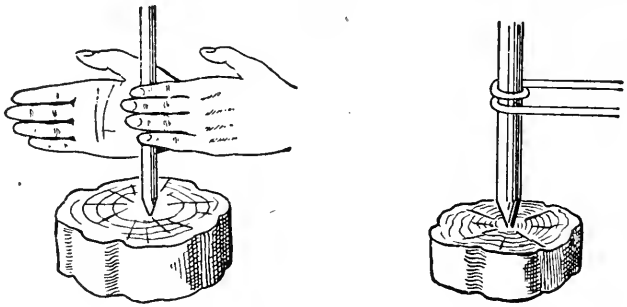


Figure 41.

ed, split as shown in A, and work out to a cross, as shown

in B. Fig. 40 is still another kind. In this, cut out the shaded parts as shown in A, and work out to the shape shown in B. These examples are enough, because it will give the idea how to work it out in almost any shape desired.

THE DRILL PRESS AND HOW TO USE IT.

Figure 42.

Fig. 41 shows the method and the drill as used by primitive man. This is the prototype of our modern drill and the endless belt. Fig. 42 shows how the drill has been perfected by Buffalo Forge Co., Buffalo, N. Y. This drill is both for hand and power; as it is ball-bearing it runs easily, and has many advantages over the old-style drills.

Drilling iron is comparatively easy, if the drill is right. It is important, in order to get a round hole, to have a drill which has the point in the center, and the shares should be of the same length and angle. We often make our own drills, but for more accurate and easy work I would suggest the use of drills and bits as well as reamers, as shown in Fig. 44, manufactured by Cleveland Twist Drill Co., Cleveland, Ohio. A shows a drill for iron and steel, B is for wood, and C is a reamer to reamer out holes which have been made too small. D is for iron or wood. E is for wood only.

In drilling cast iron, no oil is needed on the drill; but

in common iron, oil should be used freely to prevent the drill from getting hot. In drilling hardened steel, turpentine or water should be used, for oil will, to a certain

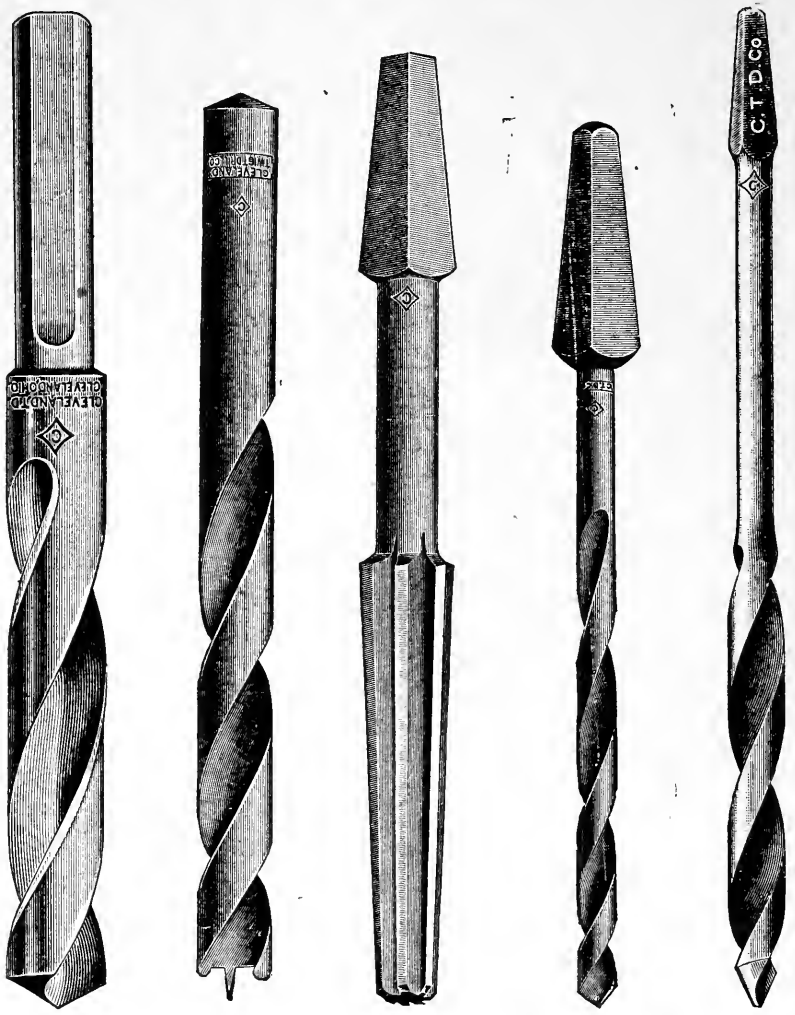


Figure 44.

extent, prevent cutting. The feed should be steady, for if the chip goes out, it is difficult to start it again in a hardened piece. The feed should not be too strong when a

light drill is used, and when the drill is about to penetrate with the point through the iron, it generally cuts in too deep, and the drill breaks; therefore it is safest, with any size drill, to slacken the speed when about ready to go through.

CHAPTER V.

WAGON AND CARRIAGE TIRES.

"If you have too many irons in the fire, some of them will burn."

In putting on new tires, proceed as follows: First, straighten the iron edgewise, then lay it on the floor and roll the wheel over it for measure, and cut the tire from one to two inches longer than the wheel will measure, for the tire will shorten in bending, because, first, the iron is upset on the inner side, and, second, it takes three thicknesses of the iron to make up for the stock taken away by the fact that the whole thickness of the material is outside of the measure taken; and, in order to have enough, cut the tire off long enough. Next measure the wheel with the tire wheel, or what is generally termed the "gauge wheel," and then measure the tire after it is bent in the Buffalo tire bender. Now if the tire is for a wagon and is one-half inch thick, cut the tire the same length as the wheel, if the wheel is much dished. If the wheel is straight, cut the tire one-fourth of an inch shorter than the wheel, for if the wheel is straight, you may have the tire from one-half to three-fourths of

Figure 46.

an inch shorter when it is welded than the wheel; but if the wheel is dished and easily bent, the tire should not be over one-fourth of an inch shorter when welded and ready to put on.

In carriage and light wheels, the tire should not have more than one-eighth of an inch draw; and if the wheel is much dished, the tire should have no draw at all, but be even with and the same size as the wheel.

WELDING TIRES.

When the tire has been cut the right length, scarf the ends. In scarfing, let the flattened edges spring out as wide as possible; then place one end on top of the other, and fit them snug together, and the flared-out corners of the top end should be bent down over the bottom end. This will hold the tire when welding in the fire. To rivet or split the tire for welding is a method used by amateurs or third-class men, but is never resorted to by experienced smiths. For welding fluid, use coarse sand, and when the tire has the right heat, place on the anvil, but, in so doing, place the tire over the inner edge of the anvil, about two inches from the scarf, and hold the tire in such a manner that the scarf will not touch the anvil before you are ready to strike; and when you strike, hit with the edge of the sledge or hammer directly over the end of the bottom tire, for this end is thin, and, if the blow is not over it, the moment it touches the anvil, it will cool off, and then this end will not stick, and you have only half a weld. This is important, and is also observed by all expert tire welders.

EXPANSION OF TIRE.

There are many ways in which to heat a tire in order to get it to expand so as to slip over the wheel. For a light

tire, very little heat is needed. A few heats in the fire of the forge is enough, for such a tire should, as before mentioned, have only one-eighth of an inch draw; and when we know that a tire will expand, when hot, three-sixteenths of an inch per lineal foot, it is clear that about two feet of heat is sufficient. A tire five feet in diameter will expand three and one-half inches.

TIRE IN SECTIONS.

In the olden times, tire was made in sections, and nailed on. We can understand that then the wheel had to be made stronger than at present. The endless tire is a great improvement over the primitive tire in sections.

RESETTING TIRE.

In resetting old tires, first mark the tire and the felloe with a center punch or chisel. Then take out the old bolts, if there are any. This done, strike with the hammer on the felloe, and the tire will come off, but remember to strike on the inner side of the wheel, for in case you should mark the felloe, the marks will then be where they are not much noticed. Still it is better to use a block placed on the felloe to prevent marking the wheel. For wide tires, a lever press should be used to press the tires off with. Next, wedge the spokes if they are loose, and if the wheel is felloe bound, saw off the felloes, so as to give the tire a chance to draw down on the spokes. Upset the tire in a Buffalo Shrinker, and give the draw according to the size and strength of the wheel, but not over an eighth of an inch for buggy tire, nor more than three-fourths of an inch for heavy wagons.

Thousands of carriage wheels as well as wagon wheels are ruined every year by ignorant smiths. It is better that

the tire should have too little draw than too much; for a dished wheel is a ruined wheel, and there is no remedy but to make the wheel over, and put in new spokes.

Back-dished wheels. It is no use to try to cure a back-dished wheel by setting the tire and giving it a good strong dish, for this will be only a temporary help. In the first quick turn, if the wheel is loaded, the wheel will spring back. To remedy a back-dished wheel, you must pull out the spokes, and put in others with the right slant or taper in the spokes, to give it the right dish. The "faith-cure" smith will tell you to screw it right with a screw, and let it stay for some time; but this is only, as I said, a "faith cure," and of no avail. There are many different ideas about the tire setting, and to refute all these whims and fads would take a volume, and, without wishing to be counted arbitrary, I will say that the method described is the only one, in order to get the best results. We often read in our trade journals of smiths who boast that they never measure either the wheels or the tire, but "set them on a guess," and they are "always correct" when put on. I don't believe in guesswork. A mechanic must learn to use the rule and the square. What would you say of a tailor you went to for a pair of pants, and he told you that he would not need to take any measure, as he always made his clothes on a guess. Now, a pair of pants are about thirty-two inches long, and a difference of about one-half inch would not make much difference; but you know that the tailor might make the pants two inches out of the way, and therefore you would not want this man to make you clothes. A tire is about fifteen feet long, and one-fourth inch too much draw would ruin the wheel, and there is no man living that can tell the difference of three inches in a tire by simply looking at it. So we see how ab-

surd such talk is, and it is the talk of the botch; still it will be presented through our trade journals, because the editor was not qualified to know the difference. I will not pay any attention to ideas like the above, and if any of the readers of this book should want to know why such and such a method is not mentioned, let me answer: The object of this book is to let you profit by my experience, and you should pay no attention to this or that. When you get older in the trade, you will see it without looking through my spectacles, and save yourself much time and poor work.

There are different tools made for the putting on of the tire, and for the holding or measuring of the tire. Any of these will answer, so I shall take no space for the description, as these are well known to every smith. There are also different methods to cool the tire, as well as heating, and you can use the method you can best afford.

COLD-TIRE SETTING.

I have very little to say in favor of cold-tire setting in repair work. In factories where new work is made, they set the tire cold to advantage, because it is time saving. The tire then is welded, and the measure larger than the wheel. The wheel is then put in the machine, the tire placed around it, and the pumps that work the rollers started. Of course, it is done quickly, but there is no uniformity in the work; one tire may have a quarter of an inch draw, while the other may have one inch draw. The man at the lever will simply let it shrink until he hears the spokes crack while they are pressed up in the hub. One wheel may give a loud crack as soon as the tire touches the rim, while the other may give no sound of warning at all. The man at the lever must use his own judgment, and guess

when to stop. Still, in heavy work, the machine is not a bad one, but it is quite different for light work, and especially in a repair shop. When a set of carriage wheels is brought to the shop to be set, in 95% of the cases the spokes are loose, and must be wedged, which cannot be done without taking the tire off, and the cold-tire setting man puts them into his machine, tightens the tire, and then we have a botch job which is liable to ruin the wheels. A great per cent. of the wheels are felloe bound, and then the tire must come off; for to set a tire on such a wheel is a sure ruin of the wheel. The fact is that there are very few cases when a tire can be set to advantage without taking it off from the wheel, and many a machine will ruin any wheel, no matter in what condition, by forcing the spokes loose in the hub and bending them out of shape. My advice is, be careful in using the cold-tire setter in repair work.

SETTING AXLES.

In order to be able to set an axle properly, one must have the right principle underlying the method. I hold that the fundamental principle is the "plumb spoke." There are different opinions in regard to what is meant by the "plumb spoke." Some hold that the measure should be a gravity measure through the center of the spoke, while others hold that the right angle should be measured from the inner side of the spoke, as shown in Fig. 47. I hold that the gravity measure is the correct measure, for we know that the spokes are tapered, and a measure along the taper would mean one-fourth inch under a plumb spoke. The wheel should stand to the plumb spoke; but if it does when not loaded, we find that a loaded vehicle stands over plumb. Therefore, in order to insure a plumb

spoke, when the vehicle is loaded, which is essential, the angle must be set so that the wheels lean out. This is called pitch, about the taper of spokes, and then the idea of setting the axle to a plumb spoke, as shown in Fig. 47, is also correct. The pitch will then be right and in conformity with the dish of the wheel. Axles are set by gauges, but then the dish must be observed, and the gauge set so as to get a plumb spoke, where the wheels have a dif-

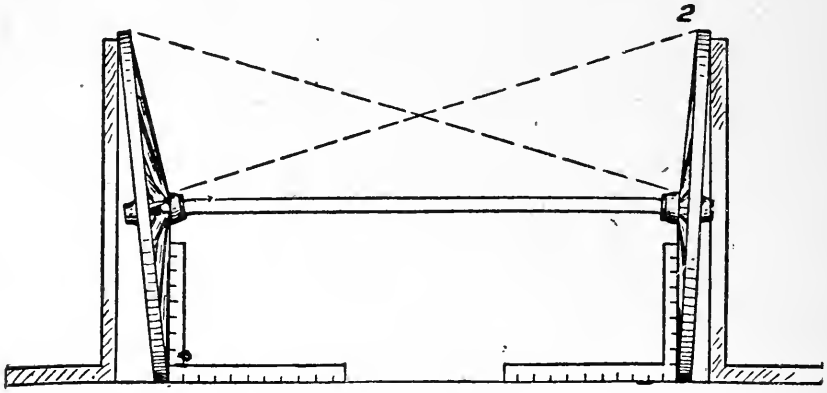


Figure 47.

ferent dish. See Fig. 47. Here one wheel has more pitch than the other, because of the different dish, but both wheels will here have a plumb spoke and track.

THE GATHER.

By "gather" is meant a condition of the wheel where the front side of the wheel stands *in* a little—from one-fourth to three-eighths of an inch—in a buggy. This is to prevent the wheel from pressing against the nut. A little gather will force the wheel against the collar of the spindle which is best. When the wheels are of the same dish, the axles can be set right by measuring with a rod as indicated by the dotted lines, and a rough estimate of the

pitch is, where the felloe is one inch thick, to have the wheels stand 1½ inches wider at the top than at the bottom of the rim. By this is not meant 1½ inches from the top of rim to hub. If the wheels are given too much

Figure 48.

pitch, the axles will wear, as shown in Fig. 48. In observing the rules now given, a vehicle will run easily, for friction is reduced to a minimum.

STUBBING AXLES.

When the spindle is worn off so there is much play, the best remedy is to weld on new spindles. First find a set of stubs the size of the axle to be stubbed. Then place the stub alongside, even with the old spindle. Of course, the length of the spindle should be the same length in the stub as in the old axle. Now place the stub so that the ends or shoulder, where the thread begins, are even. To measure from the end of the threaded part is not safe, for that part will vary in different makes. Now push the stub out so that it stands three-eighths of an inch longer than the old axle. Then mark, and cut it off. This will make the axle right when it is welded for axles up to 1½ in. square. Next upset and scarf as shown in Fig. 11. In welding use borax and sand for welding fluid. When the stub is welded, set it square with the other end; for if there is a twist in it, it will change the bearing or unfit the bed block. Now comes the setting of the pitch and gather, of which we have spoken in the preceding article under the caption "Setting Axles."

ROCK DRILLS.

It is often observed that it is very difficult to find a smith who knows how to harden and temper rock drills; but the trouble begins when the smith puts the steel in the fire Overheating is the cause of all the mischief in tools of highly carbonized steel.

For rock drills, good tool steel must be used. The most common size is five-eighths round or octagon steel. The shape should be a cutting edge, with the corners a little rounding, and not, as some prefer, a diamond point, for it is very difficult to harden a diamond shaped rock drill, for the point is liable to be too hard, while the corners are too soft. In hardening, heat to a low red heat, and cool off in water. A little salt in soft water makes a very good hardening fluid for all purposes. Place the drill in the water just deep enough to harden, and leave heat left in the drill to draw the temper. Then take it out of the water, and brighten. Now watch for the temper When the edge is yellow, cool off. Another method is to heat and place the drill in a trough where there is water only one-half an inch deep, and do not draw the temper, but place it in the water, and let it cool. If the heat is right, this method will give satisfactory results; of course, some will break at the water line.

HARDENING FLUID.

In our day, we hear much about hardening compounds and welding compounds. An old smith once bought a receipt for a hardening compound, and paid a stiff price for it, and now I shall throw it in free to every reader of Standard Blacksmithing: Aqua, one gallon, Chloride of Sodium, four ounces. This receipt he kept as a great secret, and succeeded remarkably well in all kinds of hard-

ening. He generally bought it in the drug store, and paid a dollar for one gallon of water and four ounces of salt. If this smith had known what a simple fluid he was using, he would have lost faith in it and failed. As it was, he thought it something wonderful, and succeeded. The fact is that soft water and a little salt is the best hardening fluid for all edge tools, but we do not like to "call a spade a spade." I know a physician who prescribed the same thing for all ills,—a four-ounce bottle of chloride of sodium and aqua,—and he had the reputation of being the most wonderful doctor in that part of the country, for 99% of his patients got well. I also believe that it would be a blessing if all physicians would prescribe the same thing in 90% of the cases which come under their practice, for 99% would get well from it. As it is now, many are poisoned; they simply go to sleep, and forget to wake up. I have been so near the grave myself that it was a miracle I was not taken off through the prescription of a lubber doctor. Still, you will buy something you don't know anything about for a hardening fluid; but if you are sensible, use salt water. Only a handful is enough for two gallons of water.

WELDING COMPOUND.

There are many welding compounds on the market. If you examine them, you will find that they are mostly borax and steel borings, or clay, borax, and steel borings. During the hard times a few years ago, a tramp blacksmith coined not a small sum by selling red clay to his brother smiths for welding compound. He dug out twenty-five pounds of red clay in a pit where clay suited to welding iron and steel was plenty; then he put it up in small boxes of about four ounces each, and sold to the smiths for 50c

per box. Now we have a company organized for the purpose of selling red clay and steel borings to the smiths for welding fluid. It is not a bad compound either, so long as the smith does not know what it is, but as soon as he finds out what it is it is "no good." There is lots of clay that is just as good a welding compound as is wanted, but, by the way, do not forget the sand pit either. Sand, clay, borax, and steel borings, scales of steel or iron, are elements of which the best welding fluid can be made, and, if you fail to make good welds with these ingredients at your disposal, there is something wrong with the man behind the anvil.

CHAPTER VI.

TWIST DRILLS.

"Search others for their virtues, thyself for thy faults."

To make a twist drill for drilling iron, prepare the shank first, the part to be fitted in the drill chuck. Next flatten the steel, and make it fully as wide as the size you wish to have the drill when finished. Now heat the flattened part, the whole length, place the shank in the vise, and with a pair of tongs take hold of the extreme end of the drill, and give one turn to the left; that is, the twist should be just once around for the whole length of the drill. Of course, it is difficult to make such a drill by hand, and get a uniform thickness the whole way. In order to make a perfect drill, the material should be turned, which is essential when deep holes are to be drilled. For shallow drilling, a home-made drill will do, but for intricate and complicated work, use a Cleveland Twist Drill Co. drill. When the drill is ready for hardening, heat to a low red heat the whole length of the twist, cool off in water, then polish, and place over a hot bar of iron, and draw the temper to a copper color.

DRILLS FOR CHILLED IRON.

Drills for chilled iron or tempered steel must be made a trifle heavier, with the share a little convexed. They should be hardened in soft water at a low heat. Draw no temper. Dip the drill in water only deep enough to cover the cutting part. In drilling, have an even pressure on the drill, and use water, not oil, to keep the drill cool.

MILL PICKS.

When the pick is dressed, heat to the proper hardening heat, cool off in salt water, dip the pick about half an inch in the water only, and cool off. Draw no temper. If the heat is right, and the pick has not been overheated during dressing, the smith will soon be able to do this kind of work first rate, provided, however, that the steel is a high percentage carbon steel.

AXES.

In our time, axes are so cheap, and blacksmiths so ignorant in regard to making and dressing of same, that some people never think of going to the smith with a broken or worn axe, for they well know that in most cases it is money thrown away. In dressing axes, the greater danger lies in overheating, because the extreme edge, being thin, is liable to become overheated before the heavier part of the axe is hot enough to dress; and it matters not how the axe is hardened and tempered, if the steel is once overheated, there is nothing to do but either to cut the burnt parts off or throw the axe in the scrap pile. When hammering the axe out, hammer equally from both sides, or the axe will be flat on one side and convexed on the other. If one corner is longer than the other, trim it off. When ready to harden, heat an even low red heat, cool off about two inches in water not too cold, then polish or brighten, and watch the temper. It will be noticed that the temper very seldom comes back even; therefore have a wet rag or a piece of ice, and touch the place where the temper runs out too quickly. By this method an axe can get an even temper, which is not possible when the axe is hardened in oil, and the oil burnt off, for the smith

will then know nothing of the uneven return of the temper. When the color turns to blue, cool off.

GRANITE TOOLS.

Granite tools are hardened by the same method given for "Mill Picks."

WELL DRILLS.

For well drills,—which are the same as rock drills, the only difference being the size,—the same method should be pursued as in rock drills. The temper might be a little softer; and in dressing, care should be taken to have all the corners diagonally of the same size.

HARDENING FILES, TAPS AND DIES.

Fill a cast-iron bucket with lead; set over the fire until the lead is red hot,—in other words, has the heat the file or tap should have when hardened; then place the file in the bucket, tanged end up. Have the bucket covered to the middle, and place the file with the tanged end against the covering, and the file will float in the lead, and hold itself against the cover, for steel is lighter than lead. This will also prevent the tong from getting hot, as that would break if it was of the same heat as the file. By this method of heating, a uniform heat will be obtained, which is essential in all kinds of hardening, and especially in files; for the files are liable to warp even at a uniform heat, and much more so if the heat is uneven When the file is of the proper heat, place in the hardening fluid end first, and draw out edgewise, to prevent warping, which is the result of moving the file in the water against the flat side. The file should be taken out of the water while there is yet heat in it to sizzle when taken out. Now, if it is crooked, place it between two pins fastened in the

side of the tank, with the concaved side up. Now take some water in one hand, and sprinkle over the curve of the file, while you hold it with the other hand between the pins in a straight position. When cool, it will be straight. I have noticed that a file hardener wil become very adept after some practice, and it is very seldom a file is found to be crooked. Taps and dies are heated the same way, and cooled off entirely, then brightened, and held over a gas burner, the flame forced onto them with a blow pipe until they show a yellow straw color; then cool off in water.

STONE HAMMERS.

Dressing and hardening stone hammers is some of the simplest work to be done by a smith; and still, if one inquires of a stone mason how many smiths he knows who can do a good job, you will find that he will mention probably one smith whom he knows, who is doing this work right. A smith who has learned the elementary rules in handling tool steel cannot fail to do a good job every time. The only precaution to take is to watch for the heat so as not to overheat; for the edges or corners of the hammer, if it is a large sized one, are liable to burn before the steel is hot enough in the center of the hammer to work. Heat to a red heat, and make the corners full, with a concaved face; this cavity to run along the length of the face. When dressed, heat to a high red heat, dip in ice cold water from one to two inches, and keep the hammer moving in the water so as to cool it off quick. Draw no temper, but cool off. When one end is done, place a wet rag on that end while you heat the other for hardening. Both ends should be dressed before either end is heated for hardening. If one end is sharp, that end must be handled

with a little more care. In this end, draw the temper until it shows a straw color. A stone hammer, rock or stone tools should not be case hardened; for if a compound of any kind is used, it will only serve to produce a hard shell, which will scale off. Use nothing but water. A weak solution of common salt may be used.

TO RESTORE BURNT STEEL.

The best thing to do with steel which has been overheated is to throw it in the scraps. However, if a piece which cannot be replaced without loss has been burnt, it may be improved by the following method: Heat to a low red heat, and cool off in water with a light solution of salt in it. Repeat this a half dozen times, and, if it can be hammered lightly, so much the better.

CAST IRON BOB SHOES.

In fitting cast-iron bob shoes to the runners, it is the custom to whittle down the runner to fit the shoe, while the shoe should be fitted to the runner. For years, I imagined that it was impossible to heat and bend the shoe without breaking it, but, after some experiments, I finally succeeded in bending the shoe so as to fit the runner. Here, as in many other instances, the trick lies in the heat. Heat the shoe to a low red heat, and in heating go slowly, and keep turning the shoe in the fire for the corners of the shoe may melt before the center is hot. When red, put in the vise or in a bending device made for such a purpose. Bend or straighten the shoe to fit the runner. The heat should be a low red heat.

MENDING CIRCULAR SAWS.

A circular saw will often crack because the bottom of

the teeth are filed with a sharp cornered file. The file should be round edged, or the saw gummed over a saw gummer. Where there is a crack in the saw, find the end of the crack, then drill a small hole, and put in a rivet; this will prevent the crack from going any further. It will also be well to drill another hole close to the edge of the saw, and then put in another rivet. The rivet will hold the edges together, and prevent the working apart of the edges, which will further break the saw. Of course, the holes should be countersunk on both sides, to give room for a head on the rivet.

BAND SAWS.

When a band saw breaks, first file the joints together, so that one end will lap over the other, one or two teeth, according to the length or size of them. Then place the band saw in a vise, so that it will be held straight. Now place silver and copper over the joint, and on top of same a little fine borax. Then heat a pair of tongs, with the jaws one inch square iron, red hot, and take hold over the joint. When melted, let go with these heavy tongs, and the same moment take hold with a pair of small tongs, which are not hot, over the joint, to close them together in cooling. If the ends of the saw are held rigid, one end should be loosened the same moment one takes hold with the small tongs, for else the saw will shrink in cooling, and pull loose in the joints.

HARDEN SPRINGS.

There are many methods practiced in hardening springs, but no man will succeed with any method until he has experimented some, for there are things we must learn through failures, and work which at first seems difficult

will often become easy after some practice. In tempering springs, remember that it will not do to use any kind of steel, and above all don't be guilty of such a blunder as to make springs out of old files, for the cuts in the file will be hammered down into the springs and render it worthless. One method: Heat to a low red heat in the dark, and cool in water. When one has found the right heat, this method is all right. Another: Heat to a low red heat, and bury the spring in dry sand. Another: Heat to a low red heat in daylight, and cool off in oil; then hold the spring over the fire until the oil is burnt off; then apply oil with a small brush, and burn off again. If this makes the springs too hard, burn off the oil three times. When you have made a few springs, you will find the right temper.

CASE HARDENING.

For iron case hardening, animal carbon should be put into the iron. This is done as follows: Place the article you wish case hardened in an iron box, together with pieces of horns, hoofs, bone, and leather. Then close the box tight with clay, and place in a fire, where it should be kept in accordance to the depth of case hardening desired. Then empty the contents of the box into water. Another method: Grind cyanide of potassium into a fine powder and sprinkle on the article to be case hardened while hot; then plunge into water. This is the most powerful compound for case hardening. For plow work, prussiate of potash is used, but it has not the power to penetrate that is found in cyanide of potassium. This is a powerful poison, and should be handled with care.

HOW TO TIP BOILER TUBES.

First scarf the old tube, and when it is scarfed down,

turn the flue on the horn of the anvil; that is, place the flue with the horn inside of the flue. Now press up against the horn, and turn at the same time; this is done to true the flue. Next scarf the tip, and hammer it out enough to slip over the tube about one-fourth inch. Next heat the tip, and drive it over the flue. Now have a half-inch rod the length of the flue, with a large washer under the head on one end, and a tail nut to tighten on the other end. When the rod is tight, hammer down the scarf with a light hammer, so that there will be no chance for cinders to get in between. Now have a big, clean fire ready, and use borax freely first, and then sand; this will make a splendid welding fluid. For a hammer, take a ⅜-inch round rod, and bend one end and use as a hammer, but strike very lightly over the scarf while the flue is in the fire, turning round all the while. Now, if you have fitted the tip and had the right size on the scarf, the flue will be right without any other trouble. Some have a piece of a shaft to go inside, and smooth it off with a swage outside; but this is not the best, for you will break the weld of one-fourth by this method. All that is needed is a shaft the size of the inside of the flue; taper it a little, and, when the weld has been taken, push the flue over this shaft, and that will smooth it on the inside. When cool, drive a wooden plug into one end, and put some water into the flue. If it don't sweat or leak, it is welded.

TO WHITEN IRON.

Dissolve ashes of ash bark in soft water, heat the iron, and dip it in this solution, and the iron will turn silvery white.

CHAPTER VII.

TO WRITE ON METALS.

"The confession of ignorance is the road to wisdom."

Cover the place you wish to inscribe with melted beeswax. After this is settled, write the inscription in the wax, but be sure that the writing will be with a sharp instrument that will lay the metal bare where written. Then fill the written words well with the following: Eight parts of nitric acid to one part of muriatic acid. Mix well before using. Let this acid remain in the letters for about ten minutes, then wash off.

TO PETRIFY.

Take an equal quantity of pebbles, powdered chalk, gem salt, rock alum, and white vinegar. Mix well, and any wood will petrify in it.

HARD CEMENT.

Iron borings and salt water; mix in a little sal ammonia.

SOFT CEMENT

White lead in oil and iron borings.

TRANSPARENT BLUE.

For steel or iron of different kinds, and for watch hands, Demar varnish, ¼ gallon; ground Prussian blue, ¼ ounce. Mix this well. This makes a fine blue color.

TO COPPER THE SURFACE OF IRON.

The articles to be coppered should be made perfectly

clean. This done, wash in the following solution: Sulphate of copper, one-half pound; rain water, one and one-half pounds. The article, whether steel or iron, will then look like copper.

BROWNING FOR GUN BARRELS.

Tincture of steel or tincture of iron (unmedicated), ¾ oz.; spirits of niter, ¾ oz.; black brimstone, ¼ oz.; blue vitriol, ½ oz.; corrosive sublimate, ¼ oz.; nitric acid, 1 drachm; copperas, ¼ oz.; 1½ pints of rain water. Mix well. Polish the barrel, then rub with quick-lime. Apply the browning fluid with a clean white cloth. Apply one coat and set in a warm dark room for twelve hours. Then rust will form. Cord this down with a gunmaker's cord, and rub off with a clean cloth. If a darker shade is wanted, repeat the application.

BRASSING IRON.

Clean the iron from all organic matter and plunge into melted brass.

TO MAKE LOOKING GLASS.

To make a finer looking glass than the common mercury glass, take 60 grs. nitrate of silver, 90 minims of spirits of wine, 3 grs. of ammonia, 90 minims of water. When nitrate of silver is dissolved, filter the liquid, and add 15 grs. of sugar in 1½ oz. of water and 1½ oz. spirits of wine. Now cover one side of a glass with beeswax or varnish or gum, to prevent the silver from sticking to one side; then place the glass in the mixture for a day or two. This will make a splendid looking-glass, although more costly than quicksilver.

TO DRILL GLASS.

Glass can be drilled by an ordinary drill, hardened, but

not tempered. The steel must be of a high per cent. carbon. In drilling, do not give too much pressure, and run the drill at a high velocity. Spirits of turpentine, with camphor dissolved in it, should be used, instead of oil, on the drill.

BRAZING.

Heat the article to a heat too hot to hold it in your hand. If the article has been polished, heat a little more, and wet it with a linen rag dipped in vinegar; then apply a mixture of German gal mixed with a little spirits of wine varnish.

TO MAKE GRINDSTONE.

Take 30 parts of river sand, 2 parts of glass, 10 parts of shellac. Melt this in an iron pot, and pour into a mold.

EMERY.

When I was a child, I asked an old smith what emery wheels were made of, and he said, "I believe they are made of steel and iron borings, etc., pressed or melted together." Emery was first discovered in the Grecian archipelago. It is found in amorphous masses and in granules in soils, and is a species of rock, or very hard stone. The Turkish emery has had a reputation for being the best. The crude ore is separated, assorted, and graded, then crushed into grains, flours, and the different sizes of grains numbered. When it comes to a number about 180, it is designated flour emery, and is separated by floating, and marked by letters.

The reason why emery cuts better than ordinary gravel or crushed granite is to be found in the fact that granite or sand, when crushed, will show a fracture of an obtuse angle, while a grain of emery or corundum will always

break square or concave fracture, and wear will not dull or smooth it as would stone of any other kind. This is the reason emery cuts, while sand or grindstone wears. Emery wheels are made in different ways and by different methods. Some are cemented and pressed, others cemented with different cement, and then put through a heating process. The emery wheel is the most useful invention of modern times. It is found in every shop, and in different sizes. It is a labor-saving tool, but like so many other useful inventions, coupled with a certain risk to life and limb. Great care should be taken in selecting the best wheels, as well as an arbor that will run true. I take pleasure in recommending both the emery and buffing wheels, as well as arbor, manufactured by the Chicago

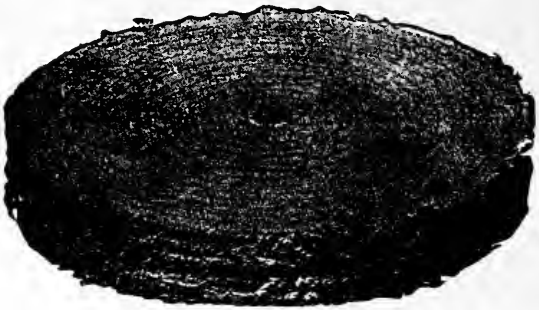


Figure 70.

Wheel & Mfg. Co., 39 Randolph St., Chicago. An illustration of these is shown in Figs. 70 and 72.

HANGING BOB BUNKS.

In making bob sleds, there are no essential rules to lay down, with the exception of the hanging of the bunks. It will be noticed in a worn bob shoe that it is worn out at one end. The front or the hind end is worn the most. This is so because the bunk is not hung where it belongs. For the front sled, hang the bunk one inch behind the cen-

ter of the tread, not the center of the runner. With a straight edge, find the center of the tread or run of the runner; then place, as before said, the bunk of the front runner one inch behind the center, and the bunk on the hind runner two inches behind the center. The front sled is generally lifted by the pull in the tongue, and needs less

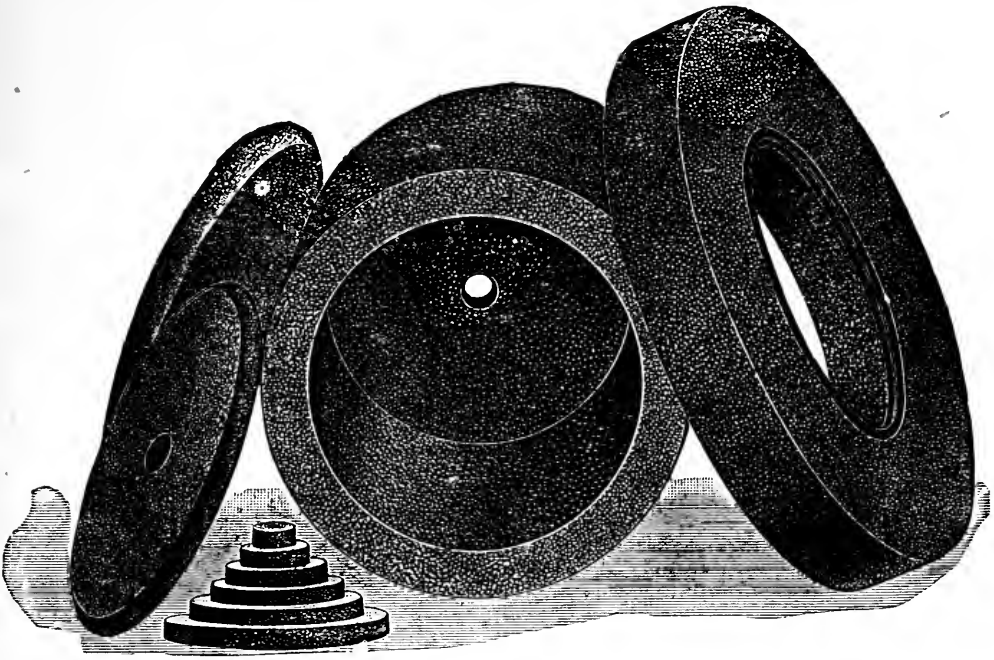


Figure 72.

back setting than the hind runner. In this method, it is found that the sleds will run easy; if, on the other hand, the bunk is hung in front of the center, the runner will run heavy in the bend and root in the snow.

RESISTANCE OF VARIOUS SUBSTANCES.

Substances.	Tensile Strain per Sq. Inch for limit of Elasticity.	Ratio of Strain to that causing Rupture.	Substances.	Tensile Strain per Sq. Inch for limit of Elasticity.	Ratio of Strain to that causing Rupture.
	Lbs.			Lbs.	
Beech	3,355	.3	Wrought-iron, Swe.	24,400	.34
Cast-Iron, English	4,000	.22	" Eng.	18,850	.35
" American	5,000	.2		22,400	.35
Oak	2,856	.23	" Am.	21,000	.26
Steel plates, blue tempered	93,720	.62	Wrought wire, No. 9, unannealed	47,532	.49
Steel wire	35,700	.5	Wrought wire, No. 9, annealed	36,300	.45
Yellow Pine	3,332	.23			
Wrought-iron, ordinary	17,600	.3			

TENSILE STRENGTH OF MATERIALS.

Weight of Powder Required to Tear Asunder One Square Inch.

METALS.

	Lbs.		Lbs.
Copper, wrought	34,000	Iron plates, mean, English	51,000
" rolled	36,000	" " lengthwise	53,800
" cast. American	24,250	" " crosswise	48,800
" wire	61,200	" inferior, bar	30,000
" bolt	36,800	" wire, American	73,600
Iron, cast, Low Moor, No. 2	14,076	" " " 16 diam.	80,000
" Clyde, No. 1	16,125	" scrap	53,400
" Clyde, No. 3	23,468	Lead, cast	1,800
" Calder, No. 1	13,735	" milled	3,320
" Stirling, mean	25,764	" wire	2,580
" mean of American	31,829	Platinum, wire	53,000
" mean of English	19,484	Silver, cast	40,000
" Greenwood, American	45,970	Steel cast, maximum	142,000
" gun-metal, mean	37,232	" " mean	88,657
" wrought wire	103,000	" Blistered, soft	133,000
" best Swedish bar	72,000		104,000
" Russian bar	59,500	" shear	124,000
" English bar	56,000	" chrome, mean	170,980
" rivets, American	53,300	" puddled, extreme	173,817
" bolts	52,250	" American Tool Co.	179,980
" hammered	53,913	" plates lengthwise	96,300
" mean of English	53,900	" " crosswise	93,700
" rivets, English	65,000	" razor	150,000
" crank shaft	44,750	Tin, cast, Block	5,000
" turnings	55,800	" Banca	2,122
" plates, boiler	48,000	Zinc	3,500
American	62,000	" sheet	16,000

WEIGHT OF ONE SQUARE FOOT OF PLATE IRON, ETC.

Thickness in parts of an inch.	Iron	Copper.	Brass.	Lead.	Thickness in parts of an inch.	Iron.	Copper.	Brass.	Lead.
1/16	2.5	2.9	2.7	3.7	7/16	17.5	20.3	19 0	25.9
1/8	5.0	5.8	5.5	7.4	1/2	20.0	23.2	21 8	29.6
3/16	7.5	8.7	8.2	11.1	5/8	25.0	28.9	27.1	37.0
1/4	10.0	11.6	10.9	14.8	3/4	30.0	34.7	32 5	44.4
5/16	12.5	14.5	13.6	18.5	7/8	35 0	40.4	37.9	57.8
3/8	15.0	17.4	16.3	22.2	1	40.0	46.2	43 3	69.2

WEIGHT ONE FOOT IN LENGTH OF SQUARE AND ROUND BAR IRON.

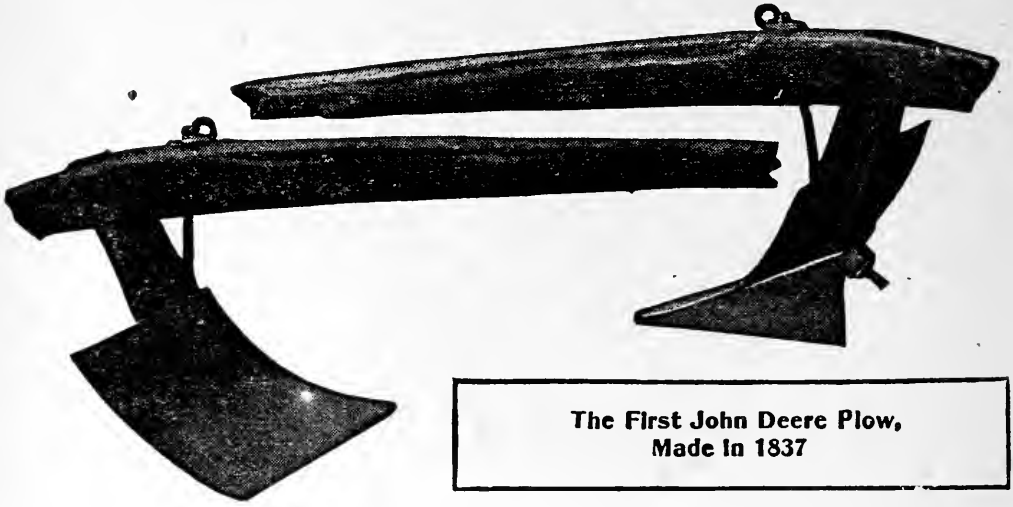
Size and diameter in inches.	Square Iron in pounds.	Round Iron in pounds.	Size and diameter in inches.	Square Iron in pounds.	Round Iron in pounds.	Size and diameter in inches.	Square Iron in pounds.	Round Iron in pounds.
1/4	.209	.164	1 5/8	8.820	6.928	3 3/4	46.969	36.895
5/16	.326	.256	1 3/4	10.229	8 043	3 7/8	50.153	39.390
3/8	.470	.369	1 7/8	11.743	9.224	4	53.440	41.984
7/16	.640	.503	2	13.360	10.496	4 1/8	56.833	44.637
1/2	.835	.656	2 1/8	15.083	11.846	4 1/4	60.329	47.385
9/16	1.057	.831	2 1/4	16.909	13.283	4 3/8	63.930	50.211
5/8	1 305	1.025	2 3/8	18.840	14.797	4 1/2	67.637	53.132
11/16	1.579	1.241	2 1/2	20.875	16.396	4 5/8	71.445	56.113
3/4	1.879	1.476	2 5/8	23.115	18 146	4 3/4	75.359	59.187
13/16	2.205	1.732	2 3/4	25.259	19.842	4 7/8	79.378	62.344
7/8	2.558	2.011	2 7/8	27.608	21.684	5	83.510	65 585
15/16	2.936	2.306	3	30 070	23.653	5 1/4	92.459	72.618
1	3 340	2.624	3 1/8	32.618	25.620	5 1/2	101.036	79.370
1 1/8	4.228	3.321	3 1/4	35 279	27.709	5 3/4	110.429	86.731
1 1/4	5.219	4 099	3 3/8	38.045	29.881	6	120.243	94.610
1 3/8	6.315	4.961	3 1/2	40.916	32.170			
1 1/2	7.516	5.913	3 5/8	43.890	34.472			

The weight of bar iron being 1; the weight of cast iron = .95; the weight of steel, 1.03; the weight of copper, 1.16.

CHAPTER VIII.

"Every way of a man is right in his own eyes."

John Deere was the inventor of the modern steel plow. When, in 1837, John Deere located in Grand Detour, Ill., he discovered that a plow to scour in the dark, soft, alluvial soil must be a well-polished steel plow. In 1837, John Deere made three steel plows from an old saw-mill saw. One of these plows was found on a farm near Grand Detour in 1901, sixty-three years after it was made. A cut of this plow is shown in Fig. 54, taken from the



The First John Deere Plow, Made In 1837

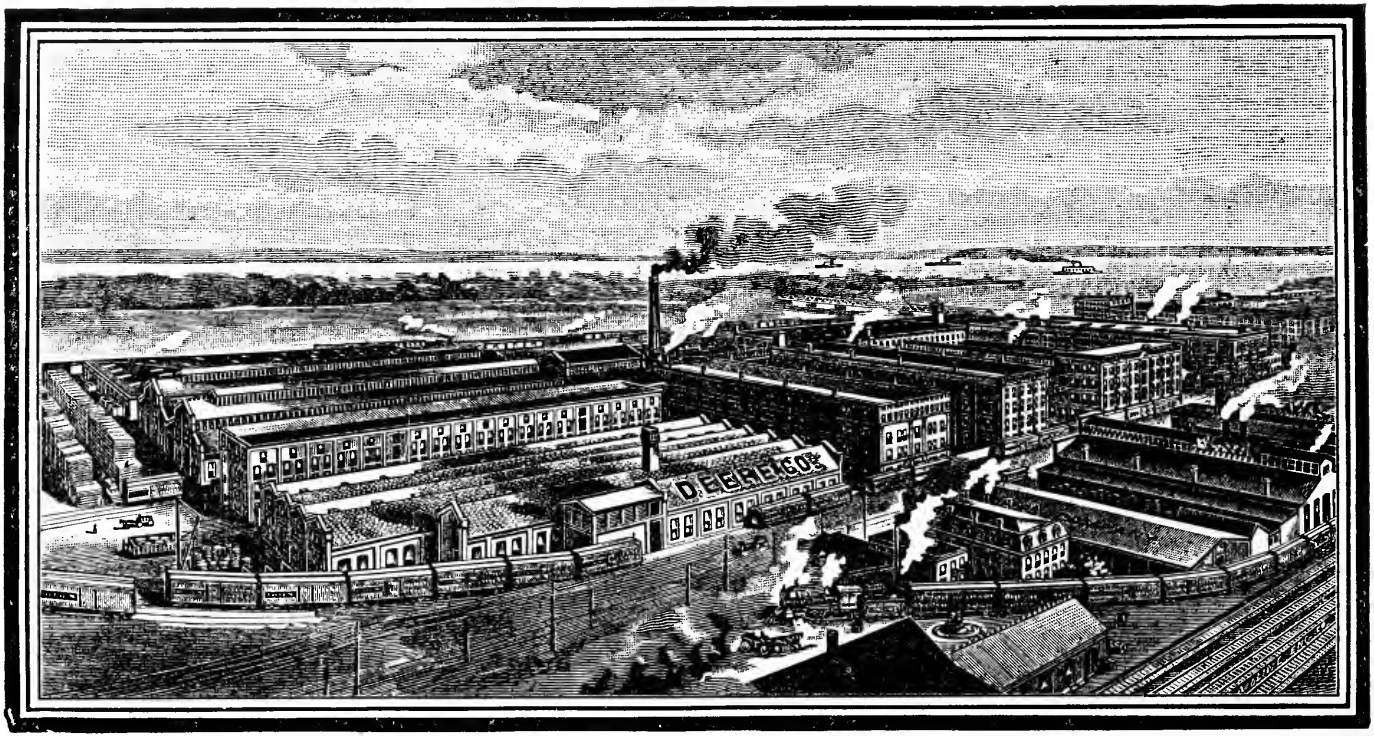
"Then the steel share and mold and landside."

Figure 54.

Central Magazine, by Prof. L. R. Whiterell. Mr. Deere continued to improve on his plows, and finally he could

not find old saws enough and of the size; so he got his steel manufactured and shipped from England, and later from Pennsylvania, U. S. In 1847, John Deere moved to Moline, and then started the making of the now famous John Deere plows.

Statues have been erected to commemorate immoral men whose only merit has been the destruction of much property and many lives, while the benefactors of mankind lie in graves forgotten and neglected; but this has been the custom by an unthinking ancestry, and it behooves us to becomingly remember the inventors who have made it


D. E. & R. R. CO.'S

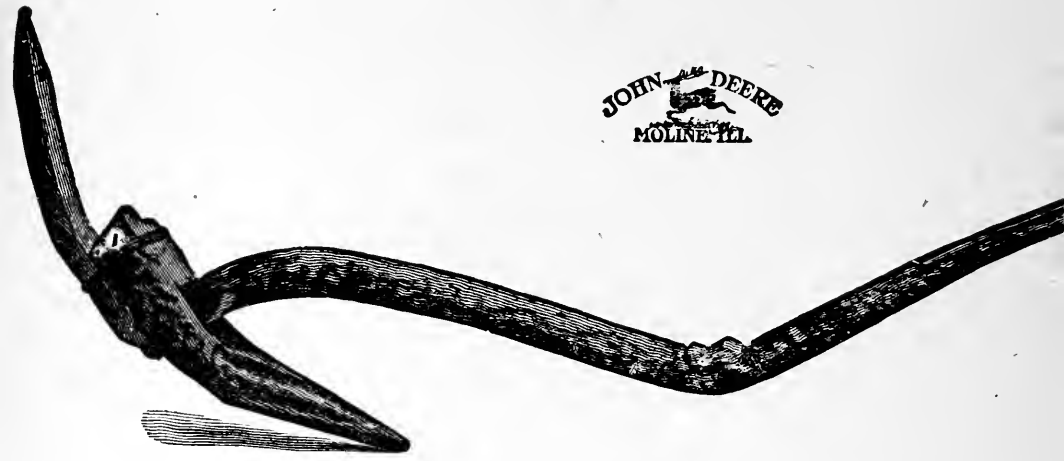
possible to make ten ears of corn to grow where formerly only one grew. Agriculture is the foundation of our national standing and prosperity, and the men who develop this branch of our industries should be remembered, first, for the mining industry, as well as all others, no matter how great they seem to be, dwarf into insignificance when compared with the product of agriculture.

The John Deere stubble plow has brought a great blessing, and been of more use than the machine gun. John Deere's corn plow has been a blessing, and only a blessing; still it will not be of such an honor to its inventor as the Krupp cannon to its maker, which has been made to destroy life and property. The one we honor, and the other we don't remember; but mankind insists on being perverted and crooked, and it takes sledge-hammer blows to straighten it out. Let us erect a statue in commemoration of John Deere.

SLIP PLOWSHARES.

There are very few smiths who can boast that they have made plows, for here, as in everything else, machinery has done away with the trade. The only thing to be done now is to repair the plow, and the most difficult part to replace is the share. In making a plowshare, prepare the landside point first. It is important, in making the landside point, to have it one-half inch wider than it should be when finished, for that much material is needed to weld down on, and if the landside is not high enough the share will be lower than the mold board, and it should be the other way. The landside point should also be fully as thick as the offset against the plate, for, if it is thinner there will be a shoulder against the end of the landside plate, and the dirt will lodge against this shoulder, and interfere

with the scouring and run of the plow. The landside point should also have the right concavity or circle; for if it is straight, like a wedge, the share will not fit down

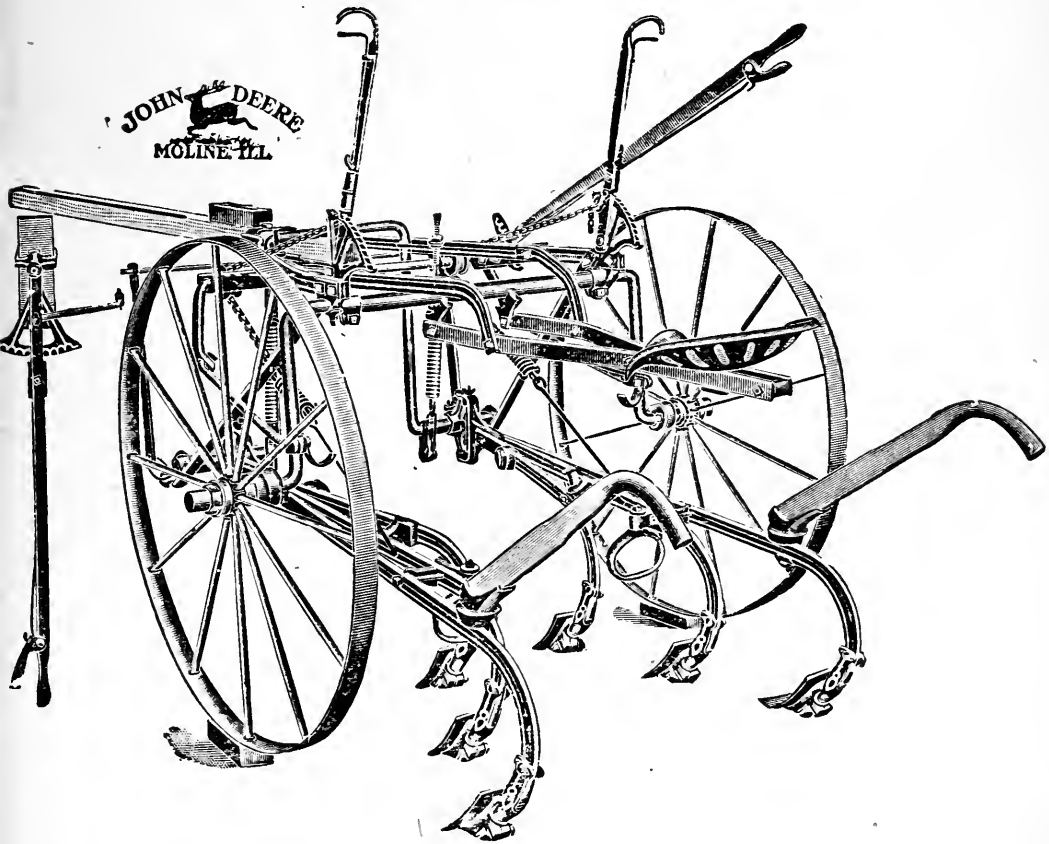


Plow 200 Years Old.

on the frog, and if it is too much of a cavity-circle-shaped, the share will rest too much or too soon on the end of the frog, but not fit up against it the whole way. The landside is the foundation on which to build the plow, and, if the landside is of the proper shape and size, it will be comparatively easy to make the share. The landside point should also have the right angle in the back-end to fit against the shoulder of the plow, and stand in line with the whole length of the landside. When the landside point is finished, place it in position, and hold it there with a pair of tongs held with the tong rings. Now, the landside point should stand in line with the whole landside, both in regard to the bottom as well as the side.

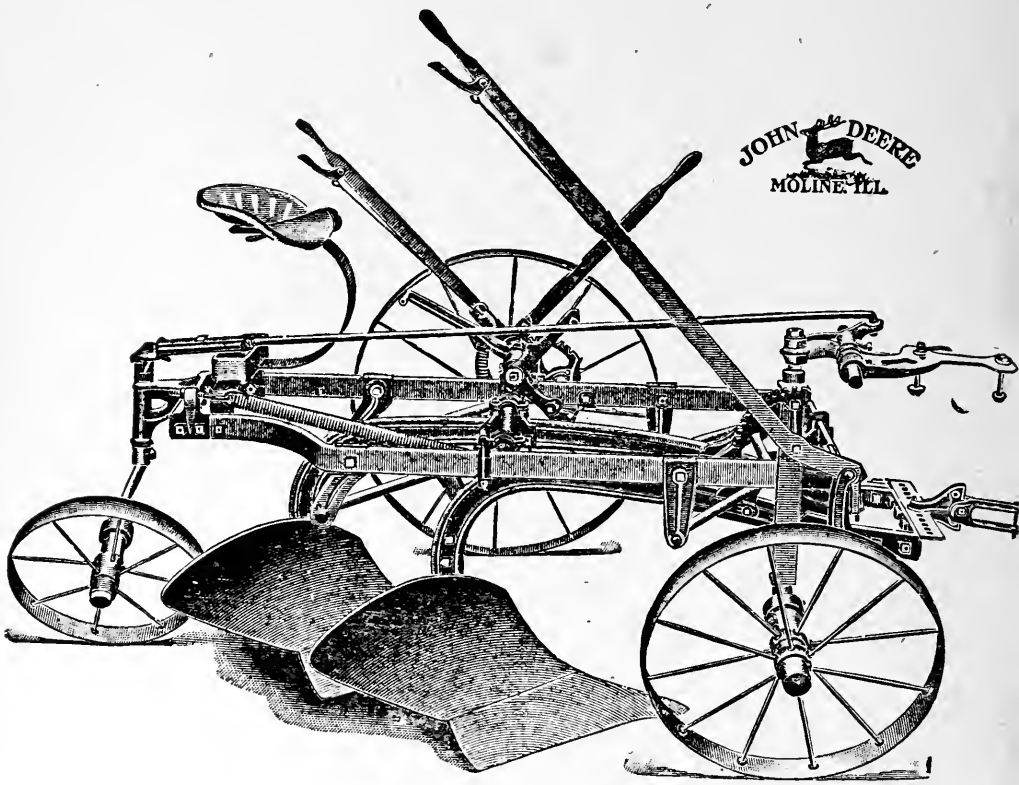
If the mold board is thick on the point, then cut a notch in landside, as shown in A, Fig. 56. If this is done, it will guide in placing the lay when it is welded, and the

joint of the lay can be placed even with the joint of the mold board. This is very important, and for two reasons: First, if the share is lower than the mold board, dirt will lodge against the joint, and the plow will not scour, the mold board will wear off, and this will in a short time ruin the plow. Another important point to remember is to have



the joints tight, for, if they are not, dirt and straw will accumulate and interfere with the plow. Now if you cannot use a blank share, take a bar of steel 6x¼ inch, and cut as shown at A, in Fig. 57. Then draw out, and shape as shown in B. Now be sure to have the angle in the

share at C, in line with the landside. This is another important point. When the share is shaped and sharpened



then bend so that the share is at right angles with the landside and edge of lay as shown in Fig. 58. This is the

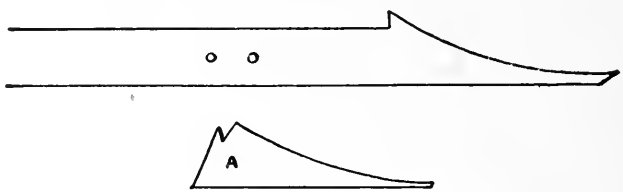


Figure 56.

right shape for a stubble plow, but for a breaker the

share should be turned up more, so as to leave a gap between the share and the square at least an eighth of an

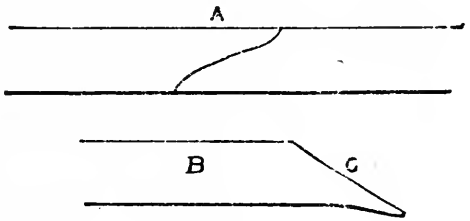


Figure 57.

inch. This should be observed in all walking breakers as the mold board in a breaker has not so much turn as in a stubble plow, and for that reason the share should be more curved.

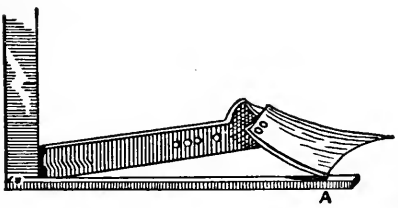


Figure 58.

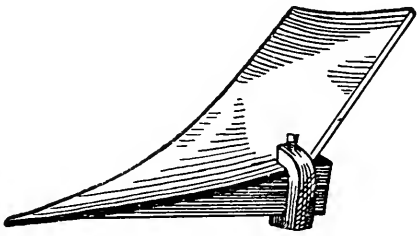


Figure 59.

In walking lays, the turn in the mold board should be observed and the share curved accordingly. Also, the hardness of the ground should be taken into consideration. A plowshare set for spring plowing, when the ground is soft, should have the edge along the heel turned up more than a share made for fall plowing, when the ground is hard. When the share has been fitted to the landside and the square,—not the brace, as many smiths

do, for the brace at the heel might have been bent out of shape and it is not safe to go by that,—then clamp the share on the landside as shown in Fig. 59. Then weld the point first as indicated by the dotted lines. You will notice that the share is longer than the landside point; therefore bend the share over and under the point, and weld. You now have the share "stuck" and in a good condition to prepare for the most important weld,—the weld of the joint. Many smiths—yes, most of them—weld at the joint first. Wrong as it is, it still comes easier to do things wrong, and I will now explain why it is better to weld and stick the point first. First, it is easier to get a weld on the point than up at the joint, where there is so much difference in the thickness of the material; second, when the point is welded, you can place the share on the plow, and see if it is a good snug fit before you weld it; and third, you can now heat the share at the joint, and fit the landside and the share tight and closely together while it is hot, for if this is not done the blast in the fire will blow cinders in between, and you will never get a good weld. I think this explains the reason why there are so few plowshares found which have a good fit and a solid weld.

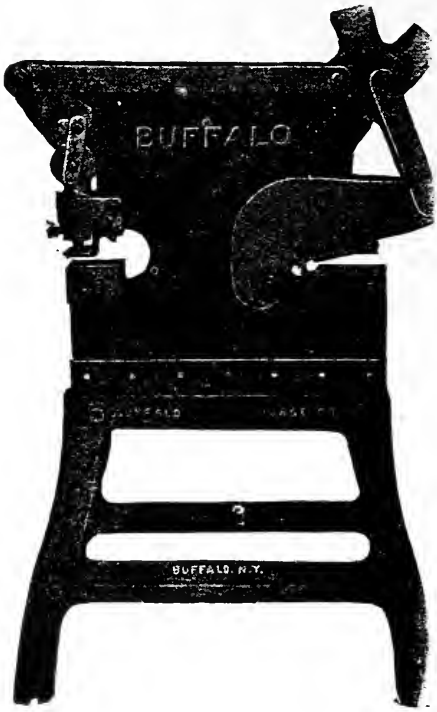


Figure 60.

In welding, have a good, large, clean fire. Use borax and sand freely. Go slowly, for if you put on too much blast the steel in the share will burn before the iron in the landside is hot enough. When the weld has been taken, place the share on the plow, and hammer it on snug while hot; then finish up the point. When welded, make the holes and punch with a Buffalo punch. See Fig. 60. When the holes have been punched and countersunk, grind and polish; then it is ready to harden, if it is a soft center; but if it is a crucible or cast steel lay, do not harden.

HOW TO HARDEN PLOWSHARES.

Our trade journals are full of advice in regard to tongs and devices with which to hold plowshares so that they shall not spring in the hardening or during the process of sharpening. Let me state right here that all these devices are failures. Even in a factory where all shares are of the same shape, have their tongs and devices proved useless, for, as soon as the share is let out of the tong, it is found that they are crooked just the same. There is one thing, and that is the only thing that will prevent warping in hardening a share; namely, the proper heat. By the proper heat is meant, first, a heat that is even, not heated with a spot too hot and another too cold, but even; second, a heat not too high, for it matters little what vise your share is held in, if it is too hot, it must warp, and, if the heat is not even, the same result will follow.

In heating a share for hardening, you will observe that it will, in most cases, spring out of shape. A good many smiths think that the warping is all in the cooling off or hardening process, but this is not so. When the share is

hot, sprinkle with prussiate of potash. Next set the share right, for you will notice that in heating it has sprung up along the edge in the center, and in cooling it will also spring or warp upward. The share should therefore be set down along the edge so much that it is about three-sixteenths of an inch too low in the middle. This done, and it must be done quickly, draw the share over the fire with the edge down, so that it will get back the heat lost in shaping, for the thin edge will cool off faster than the lay. Now plunge into a barrel of salt soft water. Do not use liquid hardening compound, for this will case harden both sides of the steel, which is not necessary, and makes the share brittle. Neither should you set the share for hardening to a leveling block, for this block, being cold cast iron, will cool off the share along the edge, and for that matter, as mentioned before, the share must stand below the square in the center, in order to come out all right in the hardening; so a leveling block is of no value for this work. You must have the share in your eye, and set it on the anvil, before you can expect to become a proficient plow maker.

DIP OF PLOWS.

The plowshares should have a dip; that is, be set down on the point from one-eighth to one-fourth of an inch. If a plow doesn't run with this dip, there is something wrong somewhere else. In gang plows, we often see a dip of three-fourths of an inch, and the result is that they run heavy and break often in striking stones and rocks.

TIPPING PLOWS.

If a walking plow is inclined to tip or lean over to the

right, roll the share up along the edge, especially on the heel. If it tips to the left, turn the edge down.

JUMPING PLOW.

If a plow runs unsteady, going up one minute, the next going too deep, the fault might be that the share is too dull, or it may not be bolted so that it is held rigid to the plow, or it may be too little dip, or the upright or beam may be loose. Look the plow over, and, if you see nothing else wrong, sharpen and give a little more dip on the point, and it will run steady.

SHARPENING PLOWS.

In sharpening a plowshare, do not hammer on the bottom side, for you will then hammer the shape out of the share, and the scales on the anvil will roughen the surface just as bad as the hammer. Have a smooth hammer and strike on the face of the plow. When one gets used to this, there will be very little hammer marks, and you can keep the shape in the share.

POINTING A SHARE.

In pointing a plowshare, do not think of all the smart instructions you may have seen in trade journals about using mower sections for points, for to do that is just so much time wasted. For points, use good steel 5/16 or at least not thinner than ¼ inch steel, and cut as shown in Fig. 61. Draw out the ends; then bend at dotted lines, the short end to be on top of the share, and the long end to go on the landside. This will make a good, solid point that

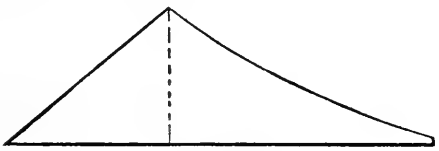


Figure 61.

will wear well, and stand the butting against stones and rocks.

GRINDING AND POLISHING PLOWSHARES.

In grinding plowshares, the grinding should be done on a solid grinding wheel before the share is hardened, for

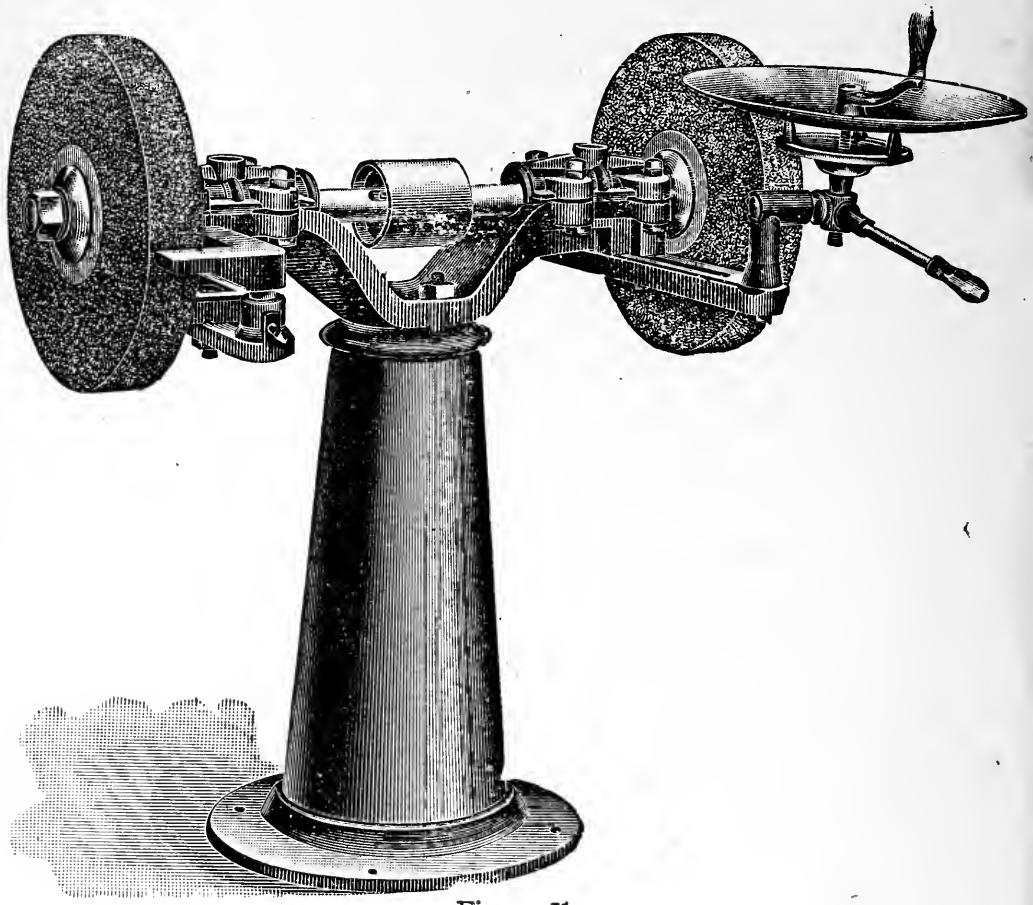


Figure 71.

if it is done after the share is case hardened, the case hardening will be ground off, and the share cannot scour. The share should be ground and polished before it is hardened; then after it is hardened, it should be lightly

polished on a buffing wheel, such as is shown in Fig. 70. This is a wheel with a flexible face, such as is required in plow work. For full information about Eureka grinders and rapid cutting emery wheels, write to Chicago Wheel & Mfg. Co., 39 Randolph St., Chicago, Ill. If the Eureka grinders and the emery wheels manufactured by this concern are used, the danger connected with the running of emery wheels is reduced to a minimum, and time is saved

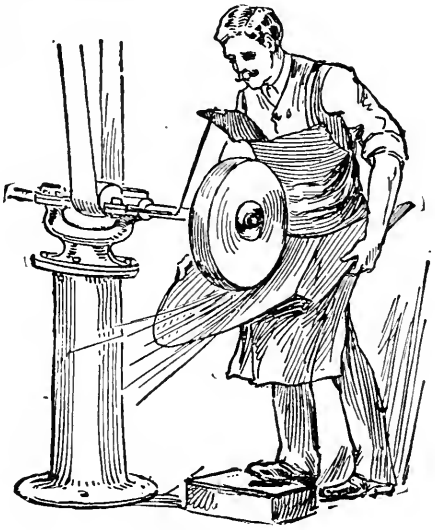


Figure 72.

by the quick-cutting qualities of their wheels. Fig. 71 shows a Eureka grinder. Fig. 72 shows their emery wheels.

CHAPTER IX.

WOOD AXLES.

"Keep the shop and the shop will keep you."

To set wood axles is the most difficult piece of work that comes to the smith or wagon shop of our time. In shops where wagons are built, they have their methods of setting the axles, but it is different in the repair shop. To make a wood axle with cast skeins on, one simple method is to set the wheels up on the floor as you would wish them to stand when they are on the axle; that is, to a plumb

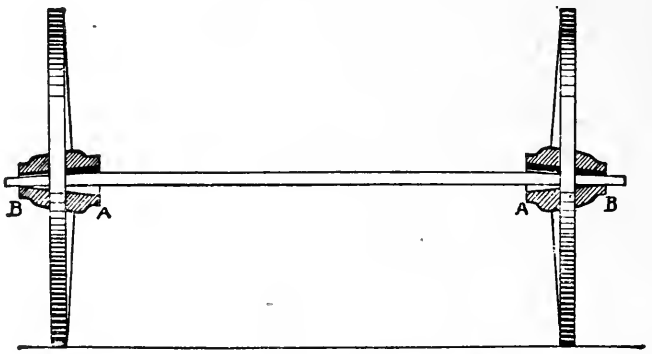


Figure 50.

spoke. Then take a straight edge which is narrow enough at the ends to go in through the box; see that it rests on the boxes at B, and you will notice that it is a space between the straight edge and the box at A. Now, this distance or opening is the amount to be taken off from the axle at B. See Fig. 50.

After the axle has been cut off this much, measure the

inside of the skein at the point, and make a circle of the size of the timber, so that the bottom of the circle will run to the bottom edge, and be one-sixteenth of an inch more turned toward the front side of the axle. This will give the gather while the first cut will be for the pitch; the rest suggests itself, and I shall only add that after the axle has been fitted for the skein, heat the skein until it is too hot to hold with the bare hand, then drive it on, and it will be a good tight fit when cold.

The pitch in an axle will be right if the spokes from the floor on the inside stand plumb, and the gather should not be over three-eighths of an inch in a wagon.

SPOKES.

In putting in wagon spokes, care should be taken to get the tenons of the spokes; that is, to fit in the hub of the same size and taper. Spokes are generally driven against a rest, so that they all stand to the same dish when driven. They may stand against the rest, but if the taper has been different, the spokes will stand in a different angle when the tire is tightened, for the spoke will then be drawn down tight, and if they are tapered different, they will give differently, and the result is a crooked and wabbling wheel. Use glue in the hub, especially in carriage work. In repair work, when one spoke, for instance, is put in, it should be fitted to the same taper of the old spoke.

In repairing carriage wheels with patent hub, be sure to remove the rivets, for this must be done to get a chance at fitting the spoke; and when the spoke has been driven, replace the rivet and set the tire.

BACK DISHED WHEELS.

I have already mentioned the method best adapted to

remedy back-dished wheels, but wish to state again that the only sure remedy is to put in new spokes with more slant on the inner side of the spokes.

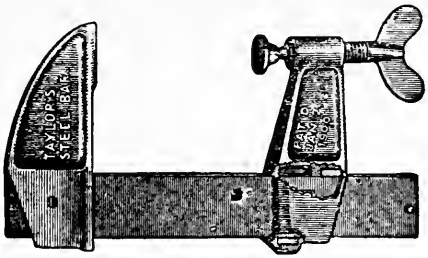
RIMS.

Steam bent rims or felloes are sometimes giving the smith and wagon maker a good deal of trouble in putting them on over the spokes, especially if the wheel is low and the rims short and heavy as in truck wheels. When the spokes have been prepared and the holes in the rim bored, begin with one end, and hammer that end on as far as it will go and not break the tenons; then have a hook to draw the spokes together with, and, if need be, straighten the felloe out. This can be done with a screw buckle or wedging it apart; if this is done, there is not much danger of breaking the tenons of the spokes. The tenons of the spokes should not be cut off lower than the rim. If they are cut off lower, as many wagon makers do, the bearing will all be on the narrow shoulder around the tenons in the spoke, and the result is that this shoulder will sink into the felloe, and then you have a loose tire or a felloe bound wheel,—probably both. Cut the tenons off even with the rim, and they will rest against the tire, and help hold up the burden, which otherwise would rest on the shoulder of the tenon.

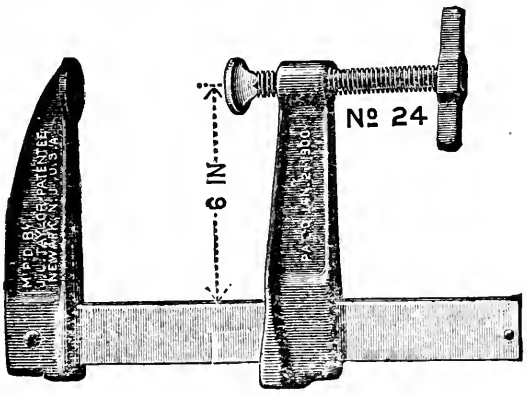
WAGON POLE.

Pole hounds are often broken, and, in replacing these, care should be taken to get the hounds on square, or the pole will stand to one side and the wagon will not track. When the hound has been shaped so as to have the right angle, clamp it on with a Taylor clamp No. 25 on the longest end, and a Taylor clamp No. 20 or No. 24 at the small

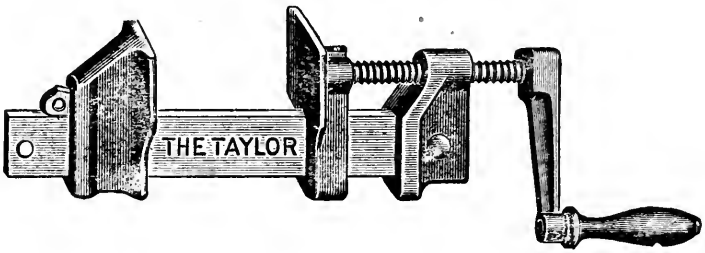
end. Now take an iron rod ten feet long, and measure from the draw bolt on both sides and to a point in the



center of the pole towards the tip or holdback. The distance from this point should be the same on both sides to



the draw hole. When this measure has been taken, bore the holes that go to hold the hounds to the tong, and then

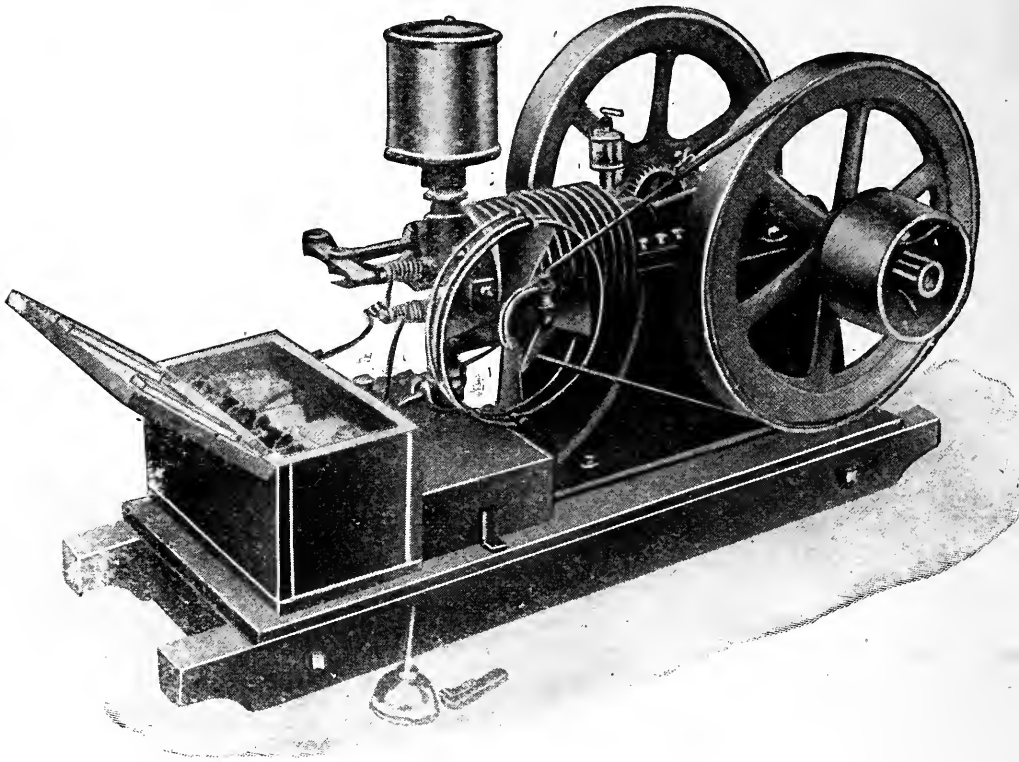


bolt the hounds to the tong. If this is done with care, the tong will run the wagon straight. If your jobber has not

the Taylor clamps, send to James L. Taylor Mfg. Co., Bloomfield, New Jersey.

DISH.

There has been some dispute in regard to the proper dish of a wheel. I do not intend to lay down any arbitrary rule for the proper dish a wheel should have, for there cannot be one measure for all kinds and sizes of



wheels. When a carriage wheel has a dish of a quarter of an inch on the outside, it must mean about one-half inch when we measure from the center of the spoke as the spokes are tapered. When a straight edge is laid over the carriage wheel before the tire is on, and it has a quar-

ter of an inch dish without the raise of the felloe, it must mean one-half inch with the felloe on, and that is enough for a light wheel. In a wagon wheel this dish should be from three-fourths of an inch to one inch.

POWER.

Power in the shop is a necessity, and no mechanic can afford to be without a Gilson gasoline engine, which is

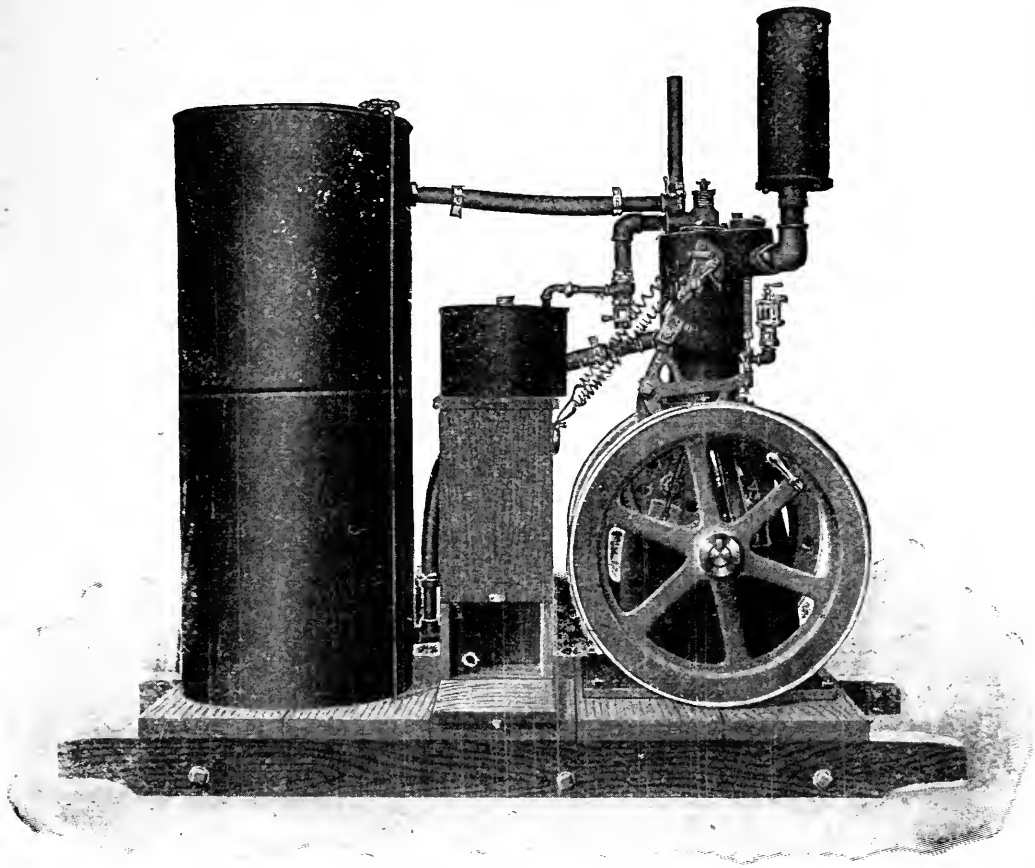


Figure 52.

now regarded as superior to all motive powers in its sensibilities to all conditions and requirements. It is cheaper and easier to operate than electricity or steam, and safer

than either. For economy and convenience, it is absolutely indispensable. Fig. 52 is another type, and Fig. 53 still another. These engines are, some air coolers, and others water coolers. They are the simplest and cheapest engines made, and easily operated, and I advise pros-

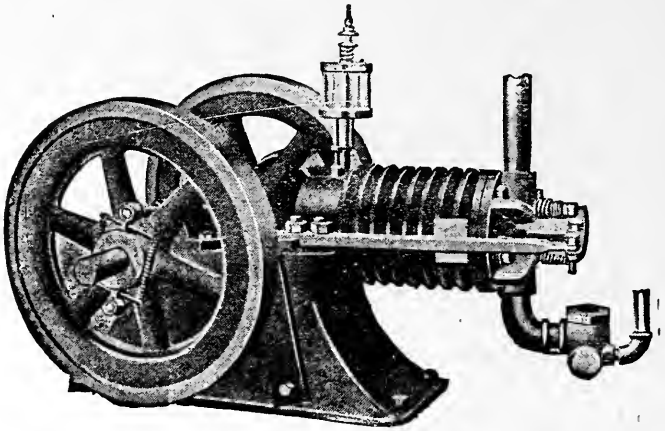


Figure 53.

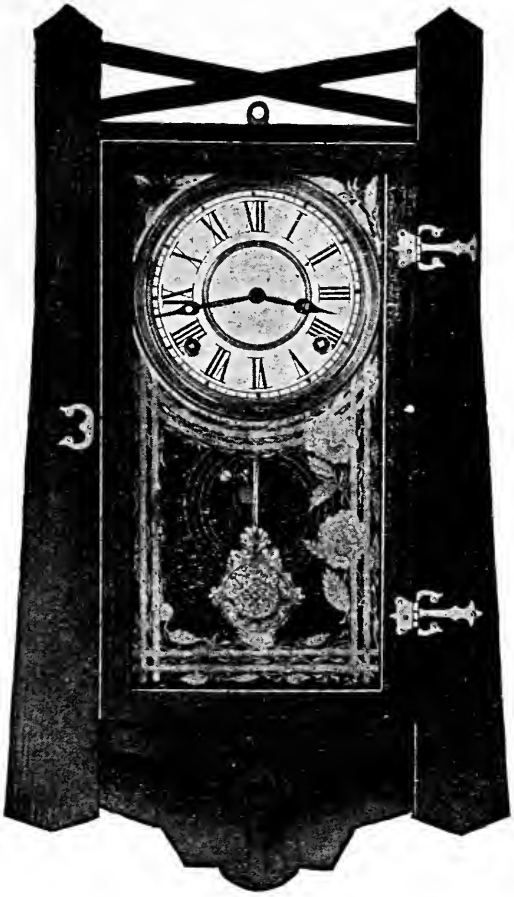
pective engine buyers to write to Gilson Mfg. Co., Port Washington, Wisconsin. If you can save $50 in the first cost, and $25 afterwards in running expenses, by buying one of these engines, you have certainly profited by following the advice of my book.

PAINTING.

The smith and the wagon maker is also the painter in the small repair shops; and it follows that, being no tradesman in that line, he must use ready-mixed wagon and carriage paint, and should always have on hand a supply of Felton, Sibley & Co.'s (Philadelphia) carriage paint and varnishes. A little experiment and practice in the line of painting will help to increase the business considerably, and it is a recreation to the smith if he can change from smithing to painting.

THE SHOP.

"Keep the shop and the shop will keep thee," is an old maxim containing a great truth. The shop should be large and high, with plenty of windows and a few skylights, for light and fresh air are indispensable to health and good humor, it is also wanted for the sake of the



work, which cannot be well done in darkness. Keep the shop clean, whitewash it once a year, and you will feel better and live longer. There is no sense in wearing

yourself out in a dark prison. Most of the blacksmith shops are not fit for a hog's house, much less for a mechanic like the smith.

Keep the shop clean, also, in regard to rubbish and scraps of all kinds; make the shop attractive and cosy. There you spend most of your time; make it worthy of you and your occupation. Use no liquor, and keep away

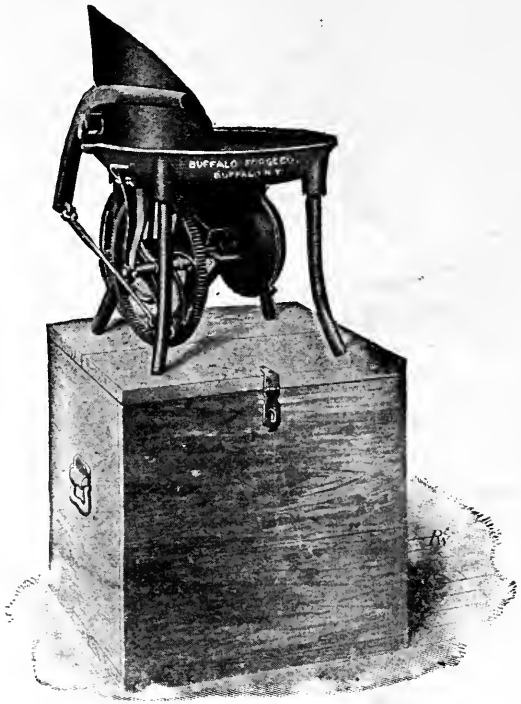


Figure 76.

from the saloons. Most smiths are spending too much of their time and money in the saloons.

Be clean in body and mind, for that is possible even for a smith. Do this, and you will be respected and the craft elevated through you. Be always on time in the morning. Have a Madrid clock in the shop, and do not allow its hands ever to pass 7 in the morning before you

open the shop. This clock can be bought for the money most smiths spend for beer in a day or two. It is manufatured by the Session Clock Co., Forestville, Conn. The time should be taken in doing different kinds of work, for there will be no guesswork; then you know what time is spent on the work. This will help you to establish prices on almost everything. Keep the time hard, and you will have no hard times.

What has been said about the blacksmithing is also true of the wood shop, and I will only add that, for convenience sake, the wagon maker should have in his shop a Buffalo forge, as shown in Fig. 76. This is a forge originally for prospectors, as it can be packed down in the box on which it stands, but it is a very handy forge for the wood worker in a repair shop, as there is much work, such as straightening irons and bolts, a wood worker could do and should do.

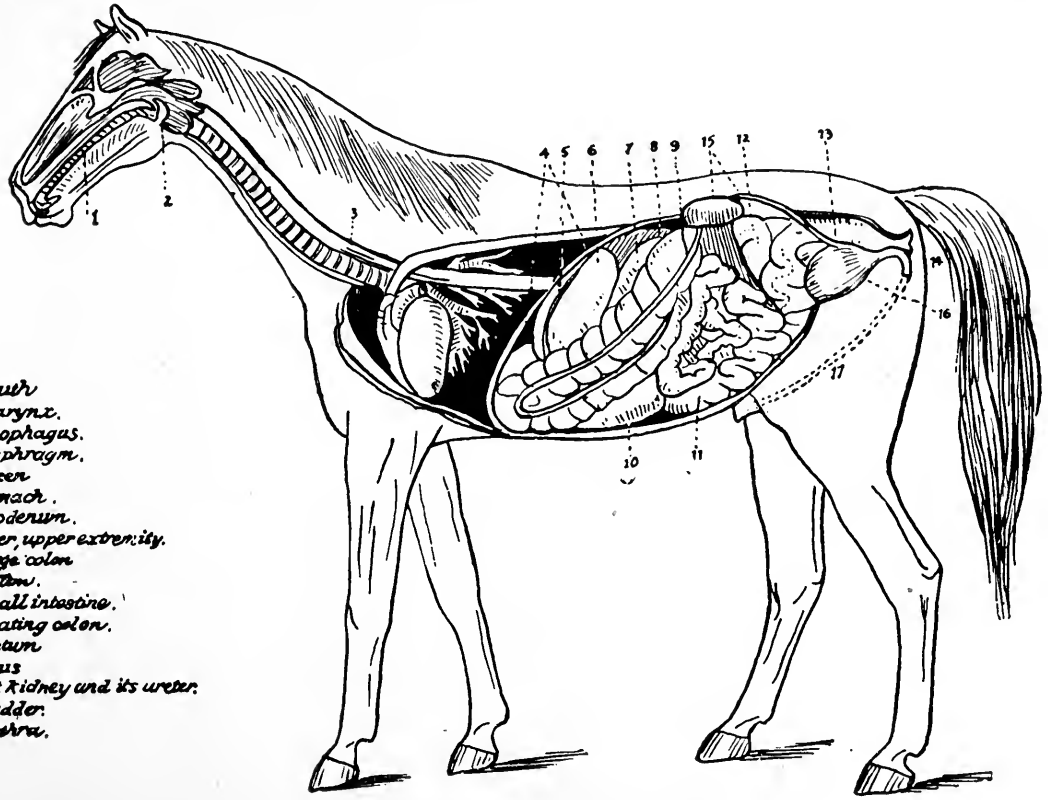
CHAPTER X.

THE HORSE AND HORSESHOEING.

The smith, as well as the curved charm—the horse-shoe—has been recognized by poets and other great men and rulers.

When Solomon built the temple, of which Jehovah was the architect, the king started out one day on a tour of inspection, and was amazed at the skill of the masons. Examining their tools, he asked, "Who made these tools?" The answer was, "The smith." Going further the king saw the wonderful work done by the carpenters and wood carvers and their clever tools and asked again, "Who made these tools?" The same answer, "The smith." Going further, the king noticed the weavers and workers of fine draperies, and asked again, "Who made these tools?" The same answer, "The smith." Turning to the superintendent the king asked, "The smith,—who is he and where is he?" The superintendent took the king by the arm and led him out behind the temple and into a little dirty shanty, and here at the anvil stood the smith pounding hot iron from which the sparks flew in the face of the king.

With reverence the king bowed to the smith and knighted him, "Father of all mechanics and king of all men."



1, Mouth
2, Pharynx.
3, Œsophagus.
4, Diaphragm.
5, Spleen
6, Stomach.
7, Duodenum.
8, Liver, upper extremity.
9, Large colon
10, Cæcum.
11, Small intestine.
12, Floating colon.
13, Rectum
14, Anus
15, Left kidney and its ureter.
16, Bladder.
17, Urethra.

DIGESTIVE APPARATUS.

Plate 1

Longfellow, supposing, as so many do now, that the mechanic is all sinews and muscles, wrote:

> The smith a mighty man is he,
> With large and sinewy hands;
> And the muscles of his brawny arms,
> Are strong as iron bands.

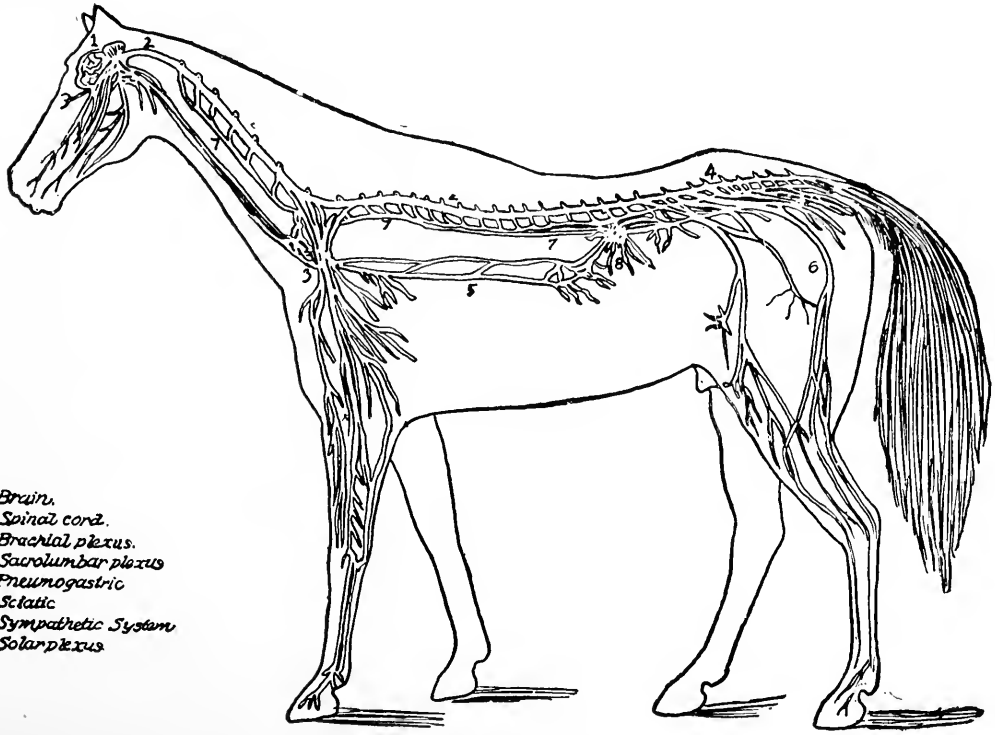
The fact is there is not a trade where the mechanic must use his brain together with muscles as in the blacksmith's trade. The smith must not only be a mechanic, but he must also be an artist. The work must be so shaped that it is not only right in construction, but beautiful in design.

The farrier's trade is a trade of horseshoeing alone, but in most cases we find the smith occupying both these branches of the trade.

When and where horses were first shod we do not know, but we know that horseshoes were first made of iron 481 A.D.

The primitive shoes were made of some soft material, like leather. Later soft metals were used. Some ostentatious ruler would, on certain occasions, have his horse shod with silver, and in some instances even gold was used. The horseshoe has ever been regarded as a charm. This superstition is shared by all nations, and not least by the American people. Horseshoes are found in almost every home, and are prized both as decorative ornaments and for their talismanic virtues. It is claimed Washington had his horse shod with shoes of gold at his first inauguration. McKinley was presented with a horseshoe at his first inauguration by an admirer. Whittier wrote: "And over many a neighbor's door she saw the horseshoe's curved charm."

In this work the author will waive any attempt to



THE NERVOUS SYSTEM.

describe primitive and ancient shoes and methods, and will treat only modern shoes and methods.

THE HORSE

The horse was one of the first animals brought under subjection for the use of man, and he is recognized among all nations as man's best friend among the dumb animals.

The discovery of the power of steam and its application to locomotion, creating the great railroad systems of the present, drew from the sages of that time prophecies that the horse would in a short time be a superfluous animal. But the horse has held his own. Later, the invention of the bicycle made the wise men of that time predict the same thing; but the horse has held his own. At present the press predicts the same fate on account of the advent of the automobile; but the author ventures to assert that the time will never come when this noble animal will not be in demand. The scope of his usefulness may be lessened; but the time will never come when the horse can be dispensed with altogether. The horse is, and has been, of immeasurable value to man, and it is our duty as horseshoers to learn as much as possible about the anatomy of the horse, especially about the feet, in order to do our duty as horseshoers, toward the horse and his owner. For it is a fact that the horse suffers untold agony while speeding along on hard roads on account of the ignorance of the horseshoer as well as that of his master.

THE SHOP

Blacksmiths and horseshoers frequently make a mistake when building a shop, to erect it on a high

foundation. A shop should be level with the ground —that is, the foundation should be below the level of the ground. It is very inconvenient to have the floor of a shop high above the level of the ground. High-spirited horses will not enter a shop where they have to walk up a high bridge, and it is also difficult to bring in heavy machinery, when such have to be repaired.

In Fig. 1 will be found a plan of a shop. This is for a horseshoeing shop. The forges are all on one side. The other side is for a shoeing floor; a dotted line being drawn the whole length of the shop to indicate gravel floor. The shoeing floor should be of plank, while the other side of the line, that is between the forges, should be a gravel floor or, if you prefer, a cement floor. A gravel floor is the best if you know how to make one. To make a gravel floor, fill with a layer of coarse sand and clay about six inches deep. Sprinkle this floor with water every night in warm weather, and in the course of a short time the coal dust in the shop will make it hard as cement and better, because it will not crack, and if it does it is easier to fix than a cement floor.

SHOEING

We are told by some learned veterinarians that the history of every horse is a record of human endeavor to mar his utility. This is a sweeping assertion, and means that every horseshoer is a bungler and does not understand his business. This may be true in many instances, but it is too exaggerated. Just think of it: a man shoes horses for from ten to thirty years and still knows nothing about horseshoeing! It is true most horseshoers do not know as much as they ought to know, because they think they know it all

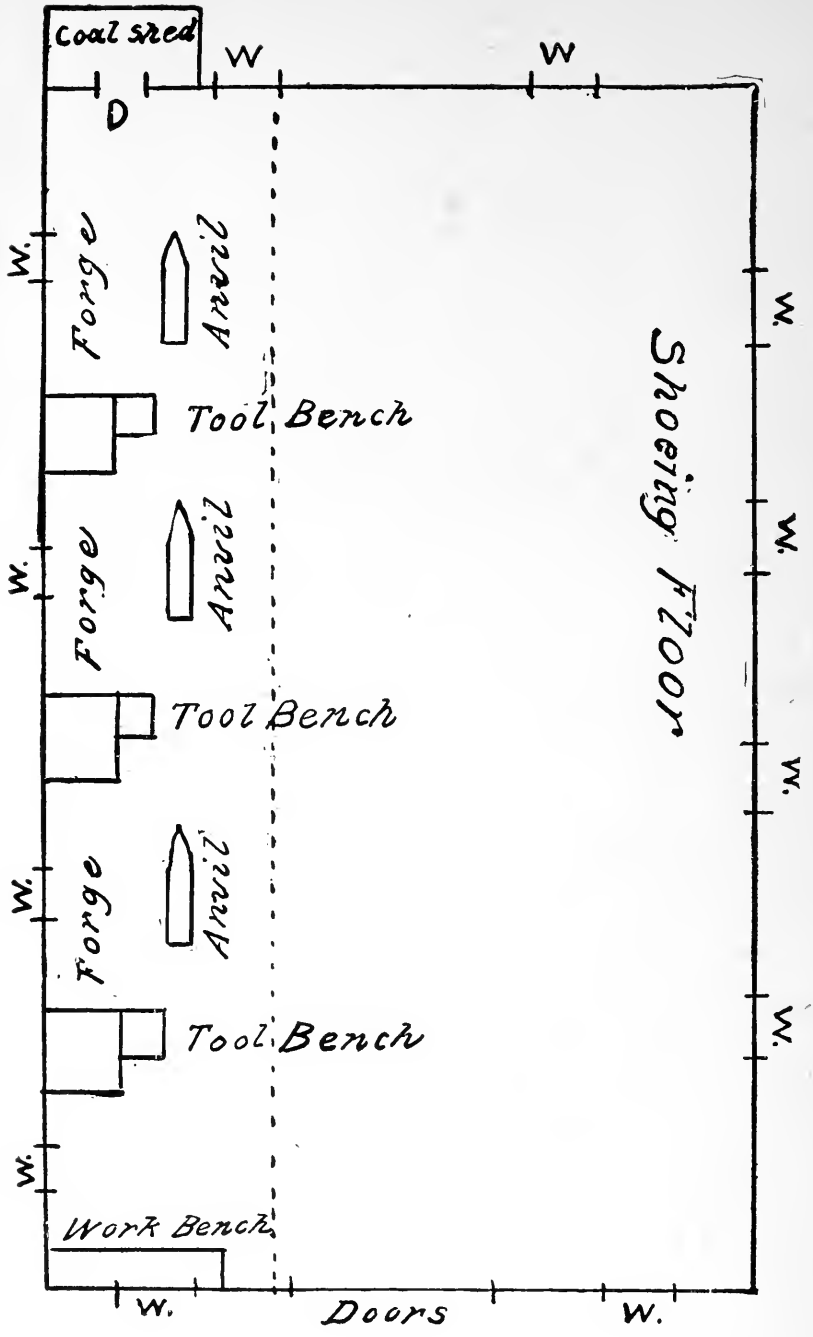
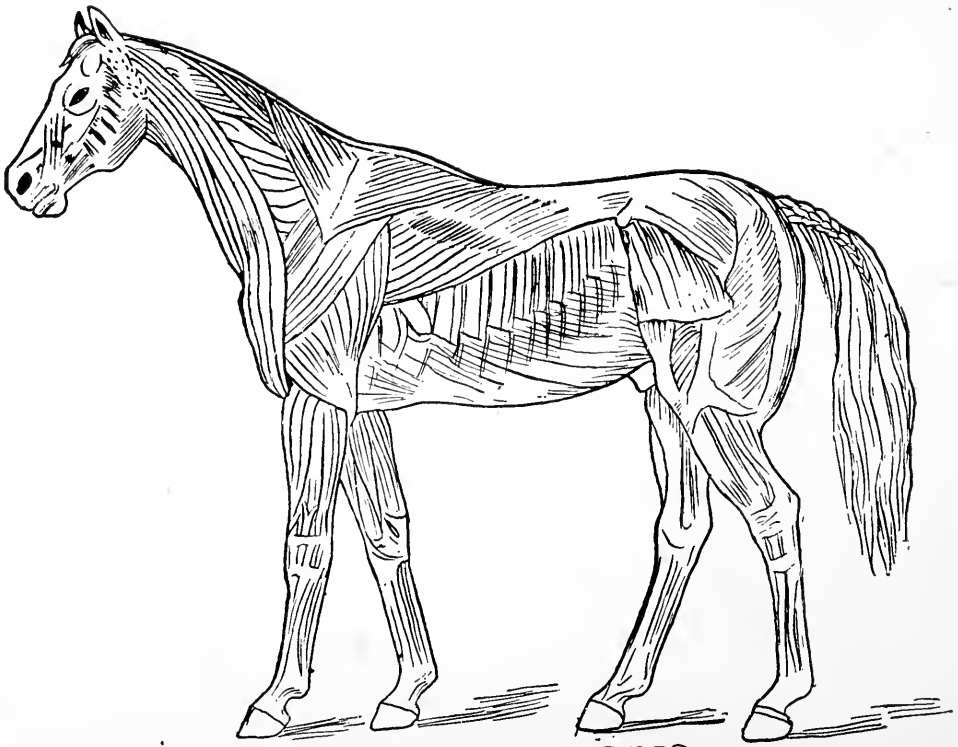

Coal shed
D
W
W
W.
Forge
Anvil
Tool Bench
Forge
Anvil
Tool Bench
Forge
Anvil
Tool Bench
Work Bench
Shoeing floor
W.
Doors
W.

Figure 1

and refuse to be informed; but after all, the average horseshoer knows more about horses' feet than our veterinarians think they do. But generally it is the rule that only the greatest botch workman is also the greatest braggart.

Horseshoeing is a necessary evil—an unavoidable consequence of the domestication of the horse. We all concur in the aphorism, "no foot no horse." Still a horse with feet so bad that he cannot walk without shoes will often be shod in such an ingenious way as to qualify him for both hard work and trotting, as well as to relieve him from suffering. No shoe has yet been invented for all-around purposes that will excel the iron shoe. We have for special purposes shoes made of leather and rubber, of which we shall have something to say in a future chapter. We will not venture to deny the fact that horseshoeing, performed by the most skilful hands, is at best attended by mischief to the foot. Each time the horse is shod and each time a nail is driven, is so much damage to the foot. But there is no immunity from this evil. When work is imposed on the horse that is of such a nature that it demands for the foot a footwear which nature cannot supply during rest, we must resort to artificial means, and the result is shoeing with iron shoes. In a wild state the horse needs no shoes. The wear and tear the feet are subjected to while hunting for food and spinning off some of the surplus of his animal energy is sufficient to keep his feet trimmed down to a normal condition. It is different when the horse is in bondage and must be used as a beast of burden, walking on hard roads and paved streets. Then his feet must be protected by shoes in default of a footwear which can be recuperated during rest.



SUPERFICIAL LAYER OF MUSCLES

Plate 21

ANATOMY

Every horseshoer should know something about the anatomy of the foot of the horse. No board of examiners should allow an applicant to pass without some knowledge in this respect. Of course this knowledge alone will not, and should not, qualify a man. It is our duty as horseshoers to ask every state legislature to give us an apprentice law, that will require every young man who expects to become a horseshoer to serve an apprenticeship of three years. We have in some states a license law; but this is only a tax on every horseshoer, as any bungler, able to pay this tax, will be given a license to practice horseshoeing, ruin horses, cut down prices and lower the standard of the shoer to the level of the botch.

THE WALL

The wall is the crust or horny sheet encasing the end of the foot, in the front and on the sides, from the coronet to the ground. (See A, Fig. 2.) It is through this wall the nail is driven, and it is upon this wall the shoe rests. In front it is thicker, toward the quarters and heels it is thinner; but it has the same thickness from the coronet to the ground edge. The white colored wall is the poorer, while the iron colored wall, when healthy, is the stronger. The growth of the wall is about three inches a year in a healthy foot and on a young horse, but on an old horse and an unhealthy foot the growth is less. The

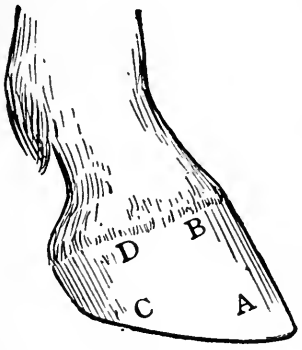
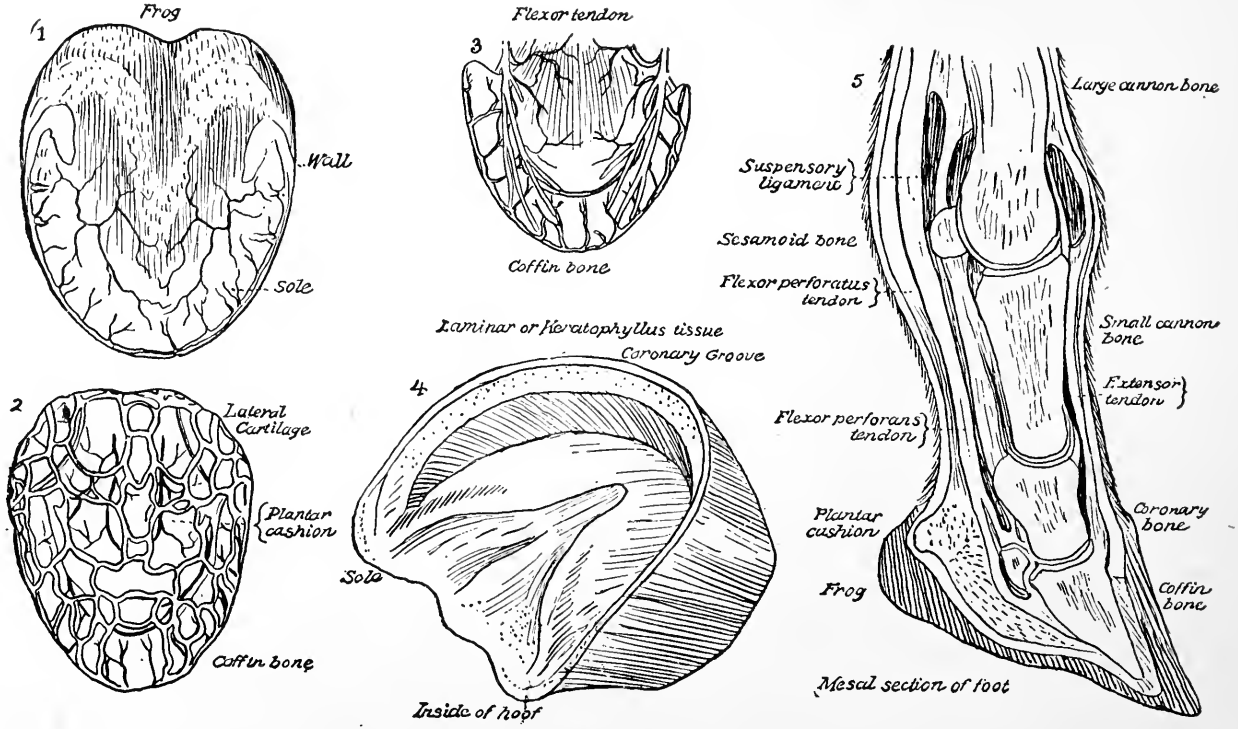


Figure 2



ANATOMY OF FOOT.

Plate 30

wall is fibrous, the fibers running parallel from the coronet to the ground.

CORONET

Coronet is the name of the upper margin of the hoof, or the place where the hair ceases and the hoof begins.

THE QUARTERS

By quarters is meant a place at the bottom of the wall, about one-third the distance from the heel to the toe.

THE BARS

The horny walls on each side of the frog are what is called the bars, or braces. These bars commence at the heels of the walls and extend toward the point of the frog. These bars serve as a brace to hold the foot in shape and prevent the wall from contracting. (Fig. 3 shows the bars marked 3, and the wall marked 4.)

THE FROG

The frog is a spongy and elastic cushion, situated between the bars at the heel of the foot. (See 2, Fig. 3.) This body is fibrous and soft when healthy. Its office is to take up jars, spread the foot, and give it a solid grip and foothold. This body is an important part of the foot.

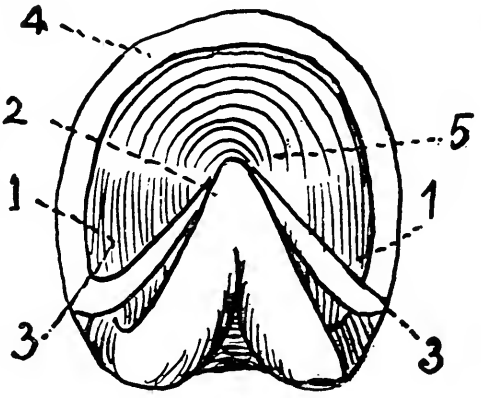


Figure 3

THE SOLE

The bottom of the foot is called the sole. The sole is horny, but soft and more fibrous than the wall. It is thickest at the borders, where it connects with the wall. In a healthy condition it scales off in cakes. These cakes should be a guide to the farrier in paring the feet. We hear so much about paring the feet, and every veterinarian has the idea that no horseshoer understands how to pare the sole; but nature has set the limit. Just follow these scales and you are all right. There are feet which have no scales to go by, and the shoer must use his judgment. In such cases be careful and go slow. It is better to cut too little than to cut too much. In most cases it is only necessary to remove the loose scales and level the walls. Nature will govern the paring. The same thing can be said of the frog. The sole is designated by No. 5, Fig. 3.

Figure 3 A

Fig. 3 A represents a tool that is indispensable to every shop. It is the best tool of its kind. I have one that I have used for over ten years, and it is just as good as it ever was.

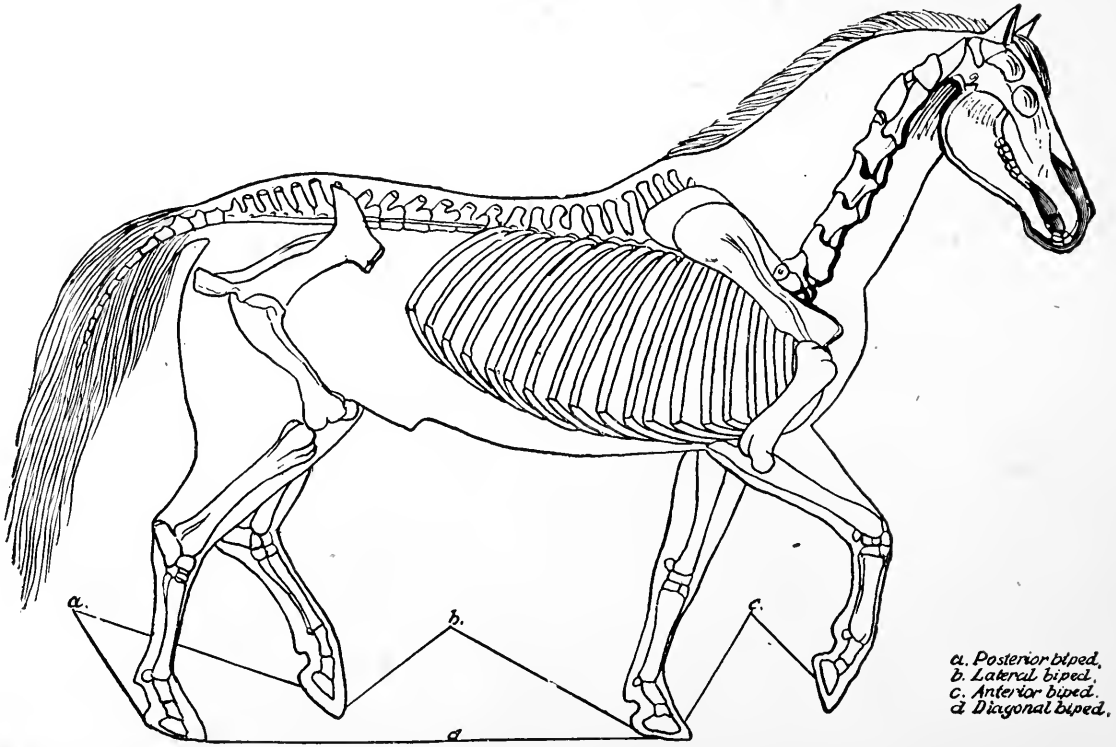
CHAPTER XI.

HOT OR COLD FITTING

In moist climates hot fitting is practiced, because it is only by hot fitting that the shoe in such a climate will stay on. By hot fitting the shoe will get a perfect fit. In a brittle hoof there must also be a good fit, or the shoe will not stay on. In many countries hot fitting is practiced exclusively, and no bad result seems to follow, unless the foot is too much pared down and the shoe, while hot, held up against the foot too long. A foot may be just as much damaged by paring down too much.

The author never practices hot fitting, except where there is a brittle hoof, or an animal is constantly scraping and kicking, so that it is difficult to make the shoe stay on. I fit cold, not because I think it better, but because the opinions of horse owners are against hot fitting, and I simply submit to the whim of my customers. A horseshoer who has practiced cold fitting all his life thinks hot fitting will ruin a horse and vice versa.

Experience with hot fitting has been had in our cavalry schools, covering a period of many years, and the results have been gratifying, as there was no damage done when the shoeing was properly performed, and the loss of shoes was 110 per cent less than with cold fitting. The advocates of hot fitting claim that it is beneficial to the feet, because it softens the foo[illegible]e



a. Posterior biped.
b. Lateral biped.
c. Anterior biped.
d. Diagonal biped.

SKELETON OF HORSE.

Plate 20

hoof oil being pressed out of the part of the foot, which would otherwise be cut off, and left as a coating on the bottom of the foot to protect the same by closing the opened pores and preserving the natural moisture in the foot. Hot fitting will also soften the hoof, making it easier to drive the nails. It is hard to understand how it can be injurious to the foot to burn off some of the superfluous horn of the bottom of the foot, which must come off by some method or other. But if the sole is cut so thin that it will yield to the pressure of the thumb, and then a hot shoe is held there until it has imbedded itself in the hoof, it is self-evident that such a procedure must hurt. The burning must be done with care, as must also the paring with the knife. For hot fitting, first pare the foot and level it, then heat the shoe all over to a red heat and touch it lightly against the foot, holding the hot shoe only a moment at a time to the foot. By a couple of touches like that there is no danger that the heat will penetrate to the sensitive laminae.

COLD FITTING

The advocates of cold fitting claim that hot fitting burns the foot until it is brittle and crisp, frying the hoof like a steak, because the hot fitting shoers are too lazy to level the foot any other way. This cannot be true, because the foot must first be leveled in hot fitting the same as in cold fitting, and in addition to this, the shoe must be heated all over, which takes considerable time, so that nothing is gained in time by hot fitting.

It is further claimed by cold fitters that the shoe will shrink when cold, making it too small for the impression made while hot. Thus we find exaggera-

tions on both sides. For one farrier to burn the foot until the shop is full of smoke, and the foot is a steak, is barbarous. For another to carve, cut and rasp until the sole is so thin that it will yield under the thumb and the blood ooze out, is criminal. A bungler will ruin a horse, cold or hot fitting, while an artist will shoe a horse right with either method. I hope some tests will be given that will settle this controversy. At present one method is just as good as the other, when the work is properly performed. In one sense there is no such thing as cold fitting. All shoes are fitted while hot, but they are not all held to the foot while hot, so as to make an impression. Still, there are horseshoers who will cool the shoe off; touch it to the foot to see how it fits; re-heat it; touch it again to the foot; strike a few blows; cool it off again, and so on for a number of times. This is the most silly of all fittings. My opinion is that hot fitting will come to the front, because our most prominent veterinarians are already in favor of it.

THE SHOE AND HOW TO MAKE IT

The shoes are seldom made by hand now, and when so made they are far inferior to ready-made shoes turned out by machinery, because no farrier or blacksmith can make a shoe by hand of such uniformity as the machine-made shoes possess. When the author learned the trade, shoes and nails were made by hand; but he is not now able to make either shoes or nails of such uniformity and finish as characterize the machine made shoes and nails. But he often hears about horseshoers telling their customers that the shoes must be made by hand in order to insure a good job, and of their charging an enormous price for such shoes. This

is especially true in shoeing trotters. No smith, no matter how clever, can make two shoes by hand exactly alike, that would duplicate as machine-made shoes do. The same can also be said of nails.

The shoe should be as large as possible, and the work the horse has to perform and his weight must be taken into consideration. The horse should not be loaded down with iron. There is a good deal of truth in the maxim, "An ounce at the toe means a pound at the withers." The calks should be low in order to keep the feet as close to the ground as possible.

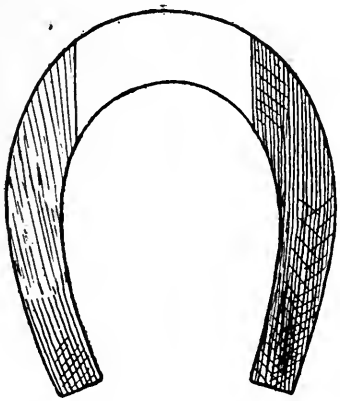


Figure 4

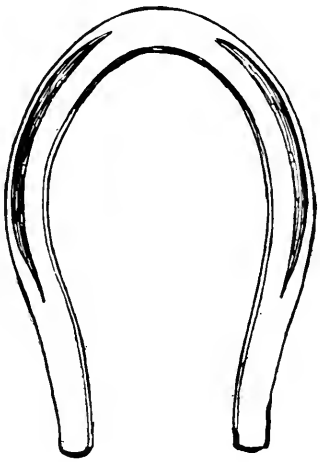


Figure 5

The purpose of the shoe is twofold: First, to prevent wearing of the foot; and second, to secure a sure grip or foothold. The first object will be attained just as well by the use of light as heavy shoes, and the second will be possible with short calks as well as high, provided they are sharp and suited to the roads and the work. The upper plane of the shoe or surface should be level. The old style of making the shoes was to make the web of the shoe incline from the out-

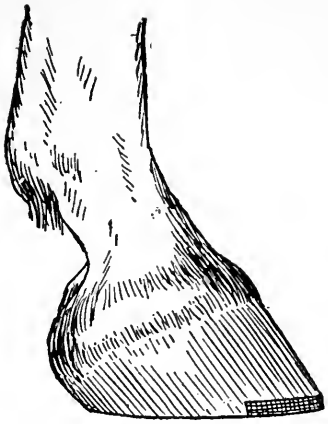
side inward. Although it cannot be proved that this shape will produce contraction as is claimed, it is just as well to make the shoes level. The shoe should be made to fit the foot, and not the foot to fit the shoe. It is generally the rule to make the shoe too much rounding on the toe. When this is done the shoe will have to be set back on the foot, or the front holes will be outside of the hoof; for it is in very few cases that the foot is round at the toe, as indicated by Fig. 4.

The shoe, in most cases, should be a little peaked, or pointed, as shown in Fig. 5. With such a shoe it is possible to reach to the end of the foot. In Plate 44 see illustration of right and wrong fitting. If the shoe does not reach out on the toe the hoof must be chopped off, as is seen in illustration, "Wrong Fitting."

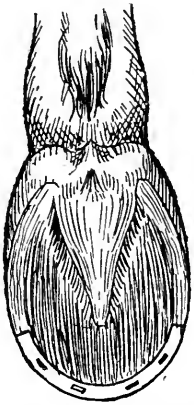
FITTING SHOES

In fitting shoes proceed as follows: First put two shoes in the fire at the same time. When red hot fasten the toe-calk; but before you do this, bend the calk a little to conform with the curve in the shoe. If it is a shoe wide on the toe bend the heels together a little, as the shoe is apt to spread and be still wider when finished. This precaution will prevent spreading, and leave the shoe the shape it had before being welded. When the calk has been fastened, put the shoe in the fire with the calk side up, and when red hot put a pinch of boraxette on the calk. Do not take the shoe out of the fire to dip it in the compound, for if you do you will lose time and sometimes even the calk, which is liable to fall off, and then again if you move the shoe you must prepare a new place for the shoe in the fire, which is not as hot as the place it had before being moved. This is a mistaken idea,

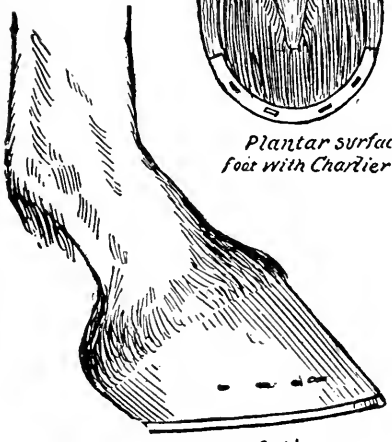
Foot prepared for Charlier tip.



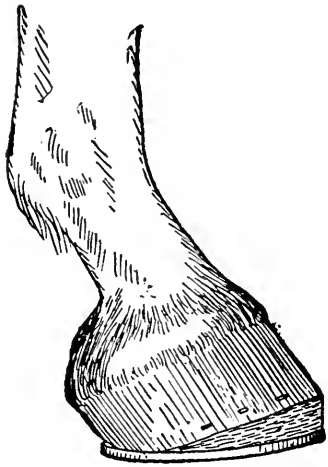
Foot shod with Charlier tip.



Plantar surface of foot with Charlier tip



Right fitting.



Wrong fitting.

and it is to be regretted that the practice of removing the shoe from the fire to dip it in the compound prevails to a great extent among shoers. Have a little spoon provided with a handle eighteen inches long, and with this spoon put the boraxette on. It always pains me to see horseshoers pull the shoe out of the fire where it is in a hot place, ready to weld, and plunge it into a box of ice cold sand, scooping up as much as there is room for between the calk and the web of the shoe. The sand will stick and make a rough looking job, and much time is lost. If sand is used, put it on with the spoon, for it takes only a few grains to make the fluid. When welding hot, hammer the calk down good into the shoe, striking in such a direction that the toe calk will stand at a right angle with the shoe on the outside. This will permit the calk to lean out on the inner side, which it should do in order to let the snowballs out. In old shoes be sure to weld on the toe calks first, because it often happens that an old shoe will break at one end of the calk. Now then, if you have prepared the hind calks first, this work is done for nothing.

In a new shoe it does not make any difference. When the toe-calk is finished punch the holes. If it is a large shoe, punch only the two front holes in the toe-calk heat, and the two hind holes in the heel-calk heat. The holes should be punched from the upper side first, and then from the creased or bottom side.

STEEL PLUGGED SHOES

In many parts of the country steel plugged shoes are used especially for winter shoeing. First prepare the plug. The best material to use for plugs is an old mower section. Put the section in the vise and break

it into small squares from three-eighths of an inch to an inch square. When the calk is ready to split, place the shoe in the plugging machine shown in Fig. 6. This is a new invention, patented by the inventor, Patrik Holmstrom, Hancock, Minn.

These calks will keep sharp if they are hardened at a high heat.

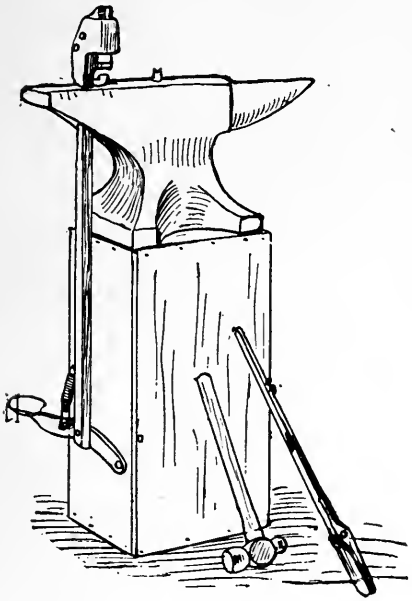


Figure 6

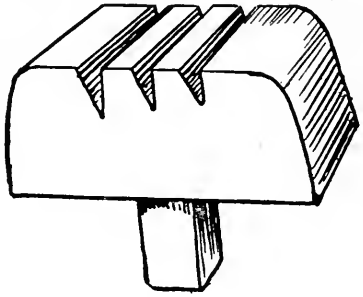


Figure 7

CALK DIE

Fig. 7 represents dies for welding both heel and toe calks.

REMOVABLE STEEL CALK SHOES

Fig. 8 illustrates a shoe that has been invented and patented by Otto A. Meyer Co., of Milwaukee, Wis. This shoe is quite a novelty and has many commendable features.

In the first place we notice that the calks are set in the center of the web, which is a commendable feature for horses inclined to interfere, or cut themselves, or other horses working along side of them. In the fore calks this feature will prevent the hind shoe from puliing off the front shoe, which is very troublesome to the driver and sometimes dangerous to the horses bent

on over-reaching. Another feature is the quick way in which the calks can be removed and replaced.

Not long ago a veterinarian brought his horse to my shop, and wanted to know how I could shoe him. Said he, "The horse is not lame, but I notice he is sore in both fore feet, and they have begun to contract; but I am on the road a good deal of the time and the horse must be shod." This horse was shod with wide heavy plates. I had the plates pulled off, and told him to lead the horse into the river and keep him there as much of the time as he could until the next day, when he was to bring the horse back to be shod.

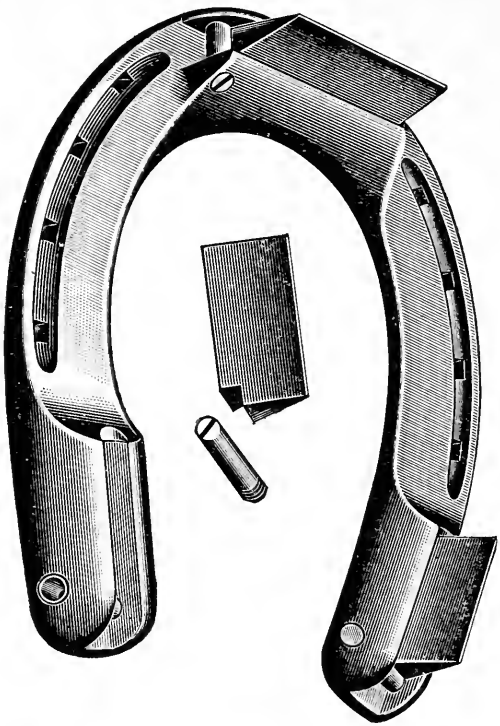


Figure 8

The veterinarian, living close to the river, did as I told him, and brought the horse back the next day to be shod. "Well," said he, "here is that soaked horse now, but how are you going to shoe him?" I told him I intended to put on shoes with short but sharp calks. He then wanted to know the use of calks on his horse's shoes. I told him that flat bar iron, like the slabs put under his horse, would jar the teeth out of the mouth and produce inflammation in the sensitive laminae, and swell the tendons in the feet of any horse, and especially a

horse like his with much knee action. To this explanation the gentleman finally gave in. I shod his horse as I said, and when done reminded him of the river close to his place—that he should be sure to have the horse spend some of his spare time with his feet in the river. A few weeks later I met this veterinarian and he told me the pointers I gave him were worth money.

Figure 7 A Bryden Goodenough

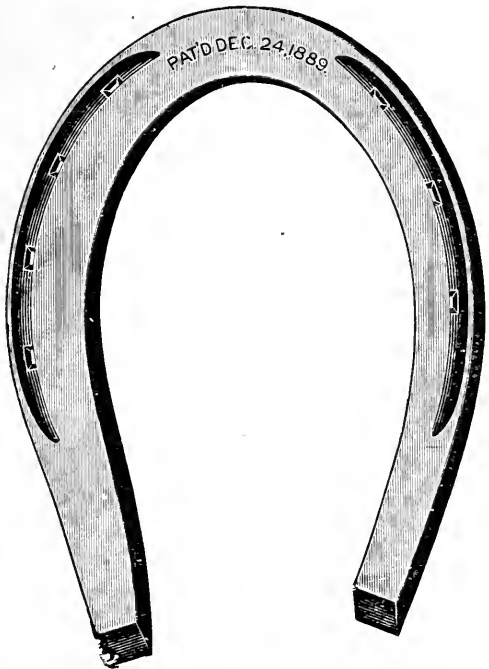


Figure 7 B Bryden Sideweight

Plates should not be used on any horse, because they are hard to stand on, being more slippery than the bare foot, and they jar the foot. Plates, when used (except as a protection to a foot cut open or otherwise in need of protection), should not be over one-half inch wide. Of

course there are objections also to calks, raising the feet from the ground, which will cause them to dry up and contract, but this is easily overcome by the use of hoof ointments, or by packing the feet once in a while.

Figure 7 C Bryden Drop Forged Shoe

Figure 7 D Bryden Shoe for Rubber Pads

The shoe in Fig. 7A is the shoe that should be used everywhere a plate is wanted, as it has a small striking surface, will not slip and takes up jars. Bryden C., as shown in Fig. 7 C, is also a commendable shoe.

CHAPTER XII.

HORSE NAILS

Horse nails are never made by hand now for the market, but there are yet quite a number of smiths in the business who have to make their own nails as well as shoes. The author's first lesson in blacksmithing was the making of nails. His first penny earned was from horse nails. Making nails is a good exercise while learning the first steps in the trade. It may happen that a man must make his nails, at any rate every smith should know how to make them in case an emergency should arise. To make a nail, first, get a nail rod $\frac{1}{2}'' \times \frac{3}{16}''$ soft steel or Swedish iron. Point the nail, as shown in Fig. 9, and cut off as indicated by the dotted lines at 1 and 2. The nail marked

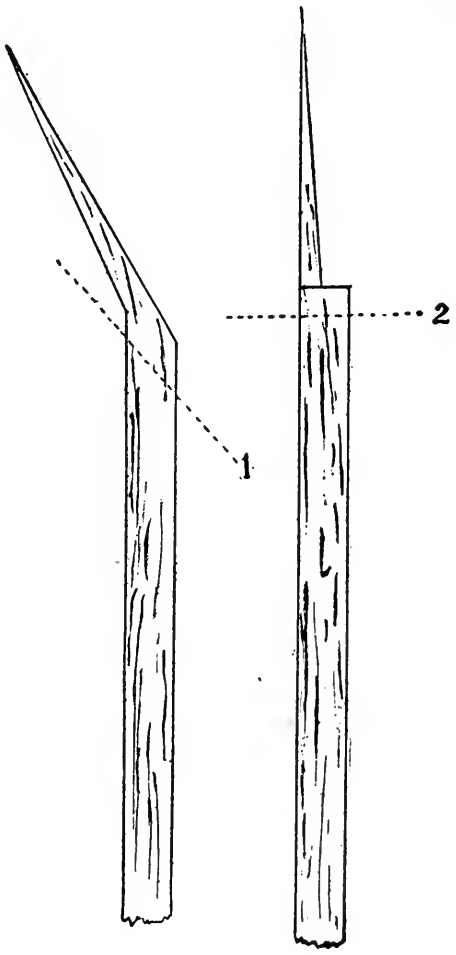


Figure 9

1 is a calk nail, so called because it has a sharp pointed head, and when the calks are worn down a few nails are pulled out and these sharp headed nails are driven in their places, and the horse will be all right for a few days. This nail is made in the same way as No. 2 in the start. After it has been forged down over the edge of the anvil, as shown in cut, then bend the nail over as shown in No. 1, and cut off over the hardy as indicated by the dotted lines. No. 2 is a common nail.

As smiths never make horse nails except for special work I take pleasure in recommending the "New Standard" nail. This is a high grade nail made of the best Swedish iron and manufactured by the Standard Horse Nail Co., New Brighton, Pa.

It is very amusing to hear the talk the different horse shoers put up in regard to horse nails. One will tell you that the "Copewell" nail is the only nail, another the "Putnam" and still another the "Star" nail. Now it is a fact that these are good nails but not any better than any other nail, the shoer has simply got used to their shape and has the full confidence in the quality of the nail, and that is of course essential in all affairs for if you have not the confidence in your material you will not have confidence in your work and if you have not, you will fail to infuse confidence in your work to others and the result is that you fail; for if we are possessed with the magnetism of confidence in any thing we undertake this same magnetism will be felt by those we deal with and success is assured.

This nail is hard enough to drive in the hardest hoof, yet soft enough to clinch easily.

If poor iron is used in making nails they are liable to split and lame the horse, even causing death by lock-jaw. Fig. 11 shows how a nail may split striking the coffin-bone.

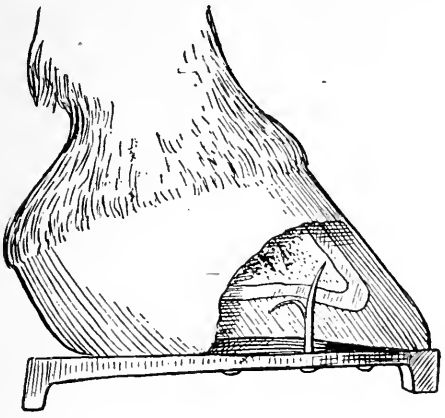


Figure 11

In England a nailless shoe has been invented and patented; but I am of the opinion that this shoe will not be of any practical value. It would indeed be a boon to horseflesh if such a shoe could be invented, enabling us to dispense with the nails. When we bear in mind that the wall of the hoof consists of thousands of hair-like tubes, cemented together, and that each tube is one of a great number of minute canals, which diffuse throughout the horn a fluid that nourishes and preserves the hoof, it can be readily understood that each nail driven into the wall closes every one of these little tubes through which it passes, thus partially cutting off the supply of a substance necessary to the foot's existence. The best thing we can do, therefore, is to use as small nails, and as few as possible. If the shoe has a level and tight bearing there is less strain on the nails, but if the leveling of the foot is carelessly done, no style of nail will prove efficient no matter how many are used and of what size.

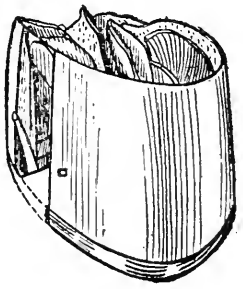


Figure 12

PREPARING THE FOOT FOR THE SHOE

The foot of a horse is quite a complicated piece of machinery, and experience has taught that no arbitrary rule can be laid down which will work in all cases. In leveling the foot be sure that it is level. Do not cut down the bars by making a V-shaped cut into the heel of the foot, between the bars and the frog, as was done by our ancestors. The bars serve as braces to hold the foot together and in proper shape, preventing contraction The frog should not be pared, as it is intended as a weight-bearing cushion. In a healthy unshod foot it always projects below the level of the sole, hence its utility in obviating concussion, supporting the tendons, and on slippery ground it prevents falling. No rule can be laid down for the angle of the foot, but we shall consider that in a future chapter, treating on the shoeing of trotters.

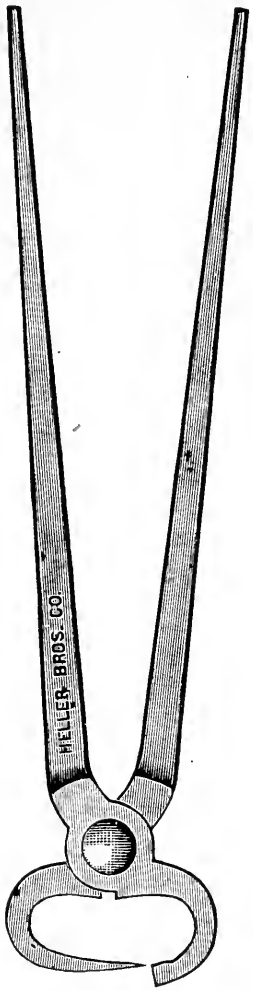


Figure 13 Hoof Parer

The sole should not be cut into more than just enough to remove the loose scales. The wall should not be cut down so low that the shoe will rest on the sole.

HOW TO NAIL THE SHOE ON

The shoe having been fitted and the foot prepared for the shoe, we will now drive the nails and fasten the shoe to the hoof. Before the first nail is driven

the shoer should be sure that the shoe is placed straight on the foot; this done, start first with one of the front nails. When the first nail is driven it will be noticed

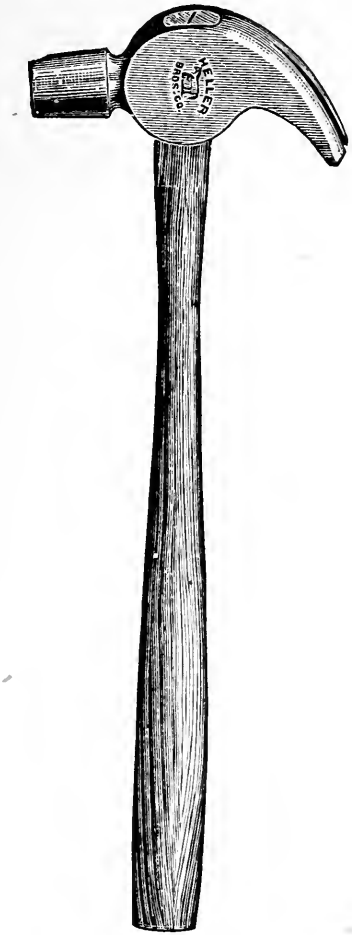


Figure 14

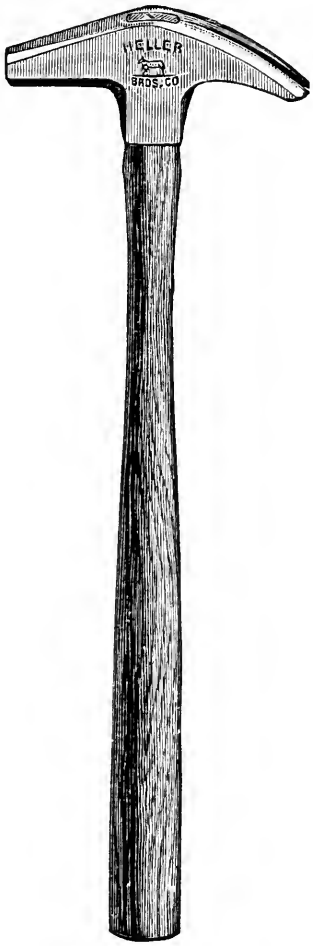


Figure 15

Farrier's Hammer

that the shoe has moved back on the foot and also over to the opposite side of the foot from where the first nail has been started; in order to guard against this it is best to set the shoe out a little over the first

nail, because the shoe will in every case slide back a little in driving the first nail. The nails should be driven so that they will follow the wall, that is, the nail should not be started too far in under the foot. But if the nail is started in line with the wall it can be driven to within half an inch from the coronet without pricking the horse. When the nail is driven there are two ways to dispose of the point of it after it has penetrated the wall. One is to twist the nail off with the claw of the hammer; the other is to bend the nail forward snug up against the hoof. There has been a difference of opinion between horseshoers as to which of these methods is the better. Both of these methods are all right. There are advantages found in one not found in the other on both sides, and the author cannot see why one method is not as good as the other. When the nails have all been driven, nip the nail points off with the pincers. Be sure not to cut them too long, for if you do the clinches will not be strong, and they will look large and clumsy, and if they are cut too short they cannot be bent over at all, which should be done in order to make a strong clinch. When the nails have all been driven, place the clinch iron on the clinch and strike with the hammer lightly on the head of the nail in order to draw the clinch. It is better to strike many easy blows than to strike a few hard

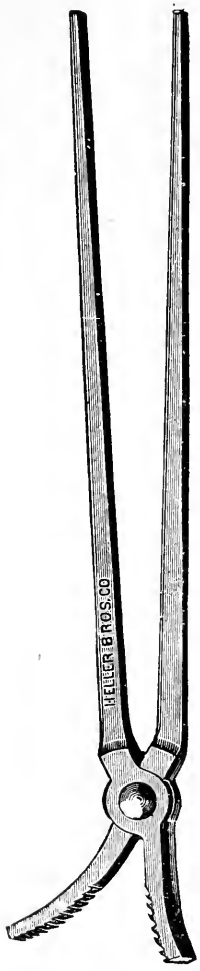


Figure 16
Clinch Tongs

ones; for if the nail is driven close to the quick then that side is soft and the nail is apt to bend that way under hard blows, which results in laming the horse. Before the clinches are clinched remove the chips from the under side of them; these chips are forced out by the nail in driving it. Some shoers will

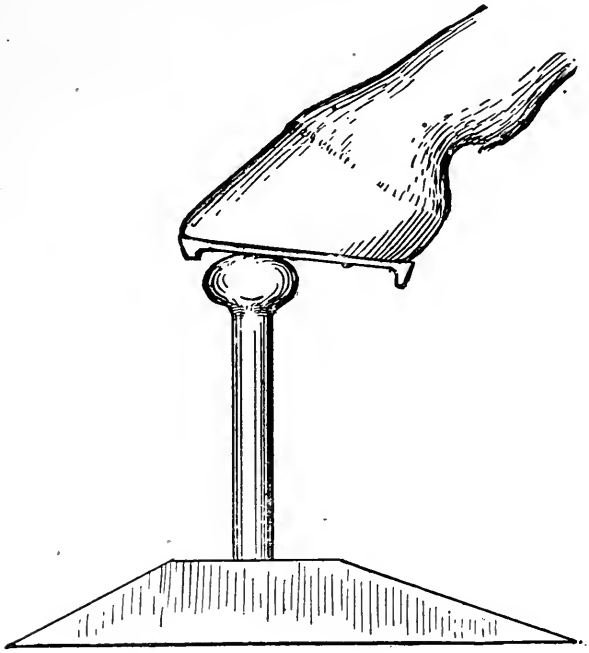


Figure 17 Foot Rest

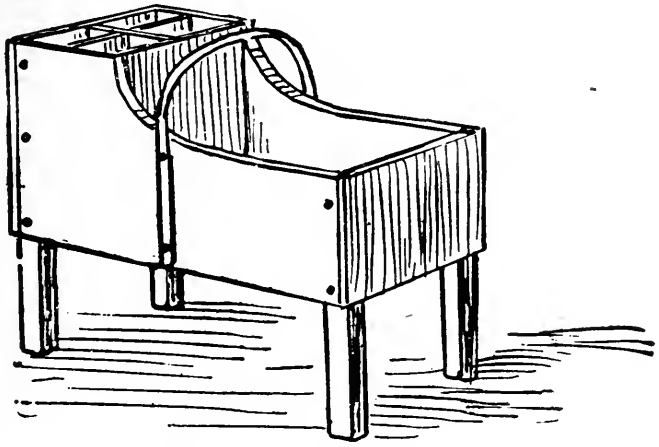
rasp these off, making a deep crease in the hoof from the heel to the toe. This is unwise, and will do a lot of harm to the hoof. The best way is to have a narrow chisel, and just cut off the chip forced out by the nail. Next, place the clinch tool on the head of the nail and bend the clinch over with the hammer, or if the horse is nervous or has a sore foot, use the clinch tongs instead of the hammer. The clinches should be short and hammered down snug. It is claimed by

some that there is no need of clinching the nails at all. Now that might be all right on a horse that is easy on the shoes and has a hard, healthy hoof, but for a draft horse it will not do. When this idea was first presented to me I gave it a fair test. In shoeing a farm team I shod one of the fore feet according to this method. The next day the farmer brought this team back, carrying one of the front shoes in his hand, claiming that I had forgotten to clinch one of the fore shoes. This settled that method with me forever. The clinches all done, we now come to that part of the job that is done by every shoer; but should be done by none, i.e., the rasping off of the hoof. But how can the poor horseshoer avoid it? The cases are rare where the foot is so uniform in shape that a shoe can be fitted which will follow the outer edge of the wall in its entirety, the feet being mostly worn off, or nicked, and sometimes grown out in projecting points, and it is impossible to fit a shoe to such a foot without rasping. Not one foot in a hundred is of a uniform shape, still we are told not to touch the hoof with the rasp. We all agree it would be better not to do so, but no man would accept a job of that kind. The best

Figure 18
Heller Rasp

Figure 19
Heller Rasp

that can be done is to fit the shoe so that as little as possible is rasped off. It is a common fault with all shoes that the holes are punched too far out on the web of the shoe. If the holes were punched further in there would be less rasping to do. Of course the projecting parts must be rasped off in all cases. There are horseshoers who claim that they never rasp the foot, but if you watch them you will find that they rasp the foot in paring to a uniform shape, and then,



Horseshoer's Tool Box

Figure 20

of course, it is easy to fit the shoe, so that no rasping need be done after the shoe has been nailed on; but whether they do the rasping before or after the shoe is nailed, they will rub some oil on the rasped part and tell you, "I never rasp the hoofs. It is the other fellow who is doing such botch work, but not I." It is true that there are shoers who will rasp the foot from the coronet to the sole level, but this kind of shoer is an exception. The hoof is covered by a fine coating of natural varnish, thickest at the upper margin. Under

this varnish the new hoof is secreted and protected until it has developed. In the rasping this varnish is destroyed, and as a result the foot will become dry and shrink, causing contraction and a diseased foot. Whenever hoof has been rasped it should be painted to prevent the air from drying up the hoof, and also preventing the hoof oil from drying up. If rasping could be done away with entirely it would be best, but as it cannot be, let us reduce it to a minimum.

HOW TO FIT AND RE-CALK OLD SHOES

It is a fact that re-calking old shoes is a more difficult job than to fit new shoes, because the old shoe

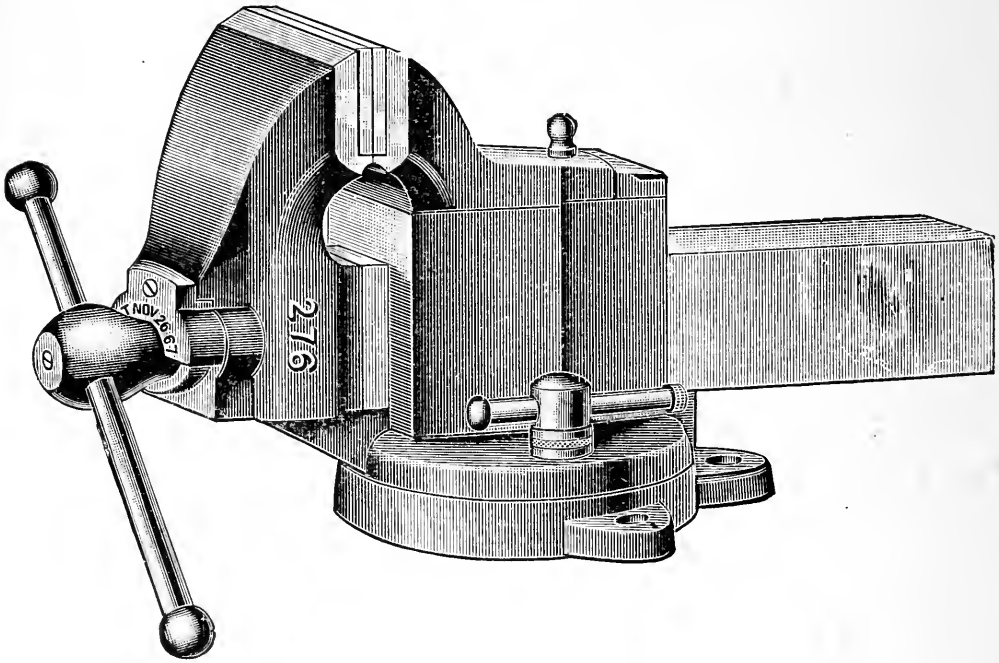


Figure 21 Wood Worker's Vise

has either been worn out on the toe, making a beveled web where the toe-calk is to be welded on, or the root of the old calk is left, and it is hard to weld a new

calk on the top of the old root. If the old calk is over a quarter of an inch long pull it off. To pull the old toe-calk off you will find is quite a job sometimes. The old calk can be pulled off in two different ways: First, heat the calk to a high red heat, then put the shoe in the vise. Illustration, Fig. 21, shows a vise that can be used for this work as well as for woodwork, and many horseshoers in the country towns are doing

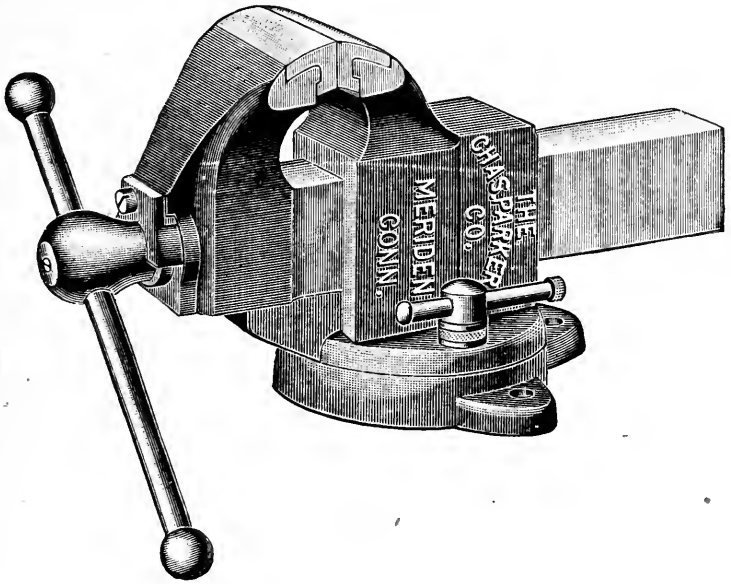


Figure 22 Iron Worker's Vise

woodwork also. But if you are doing general blacksmithing and horseshoeing only, then the vise illustrated in Fig. 22 is the best. These vises are not of the common kinds as the illustrations indicate, but I cannot here go into detail in describing these tools, and would advise every mechanic to study the illustrations closely. The manufacturers will explain these novel tools if you will write to them for information. Now take hold of the toe-calk in that end where there

is no tit, for that end is always the most solidly welded end. A solid jerk will start the calk, and once started it will come off easily, but if it cannot be started with the pincers for want of a good grip, then take an old rasp and place the end of the rasp at the edge of the vise, with the other end lift up, catching the calk at the titless end, and the calk will come off, provided the shoe is held fast in the vise. Next proceed to weld on a new calk. If the old calk is well worn off, it is best to hammer it down to a level with the web, and weld a new calk on top of it. This is not so easy if the shoer is

Figure 23 Pincers

not a good smith. To do it the shoer must be a good smith, knowing how to weld steel. He must have a good fire and plenty of blast; not that so much blast is needed for this work, but with a good blower the minute cinders, always present in an old fire, can be blown out of the fire, by stirring in the fire and at the same time blowing with force.

For welding steel of all kinds no compound is better than Boraxette. This compound, as well as the blower, is for sale by all jobbers in blacksmiths' supplies.

THE ANVIL

The anvil of to-day is as it was when some of us learned the trade from thirty to fifty years ago. There is not an anvil made practical for all-round blacksmithing and horseshoeing. We have seen some special anvils made for some special kinds of work, but the face of such anvil is generally so mutilated that it makes the anvil useless for common blacksmithing. The author has made arrangements with Fisher & Norris, Trenton, N. J., manufacturers of the "Eagle" anvils, to make an anvil more suitable for all-round blacksmithing and horseshoeing. This anvil is intended to answer the requirements of the smith doing all kinds of work. The extreme edges, which are of no use, but which will be knocked off the first week, are taken off to make the anvil suitable for plow work, such as shaping plow lays and cornplow shovels. The inner side of the tail end (butt end) is rounded for 2½ inches. This is for pointing the toe of horseshoes. As the anvil is now, this pointing has to be done over the horn of the anvil, with the heel of the

shoe resting over the horn, and the toe held in the tongs, with no other rest than the grip of the tongs. This will straighten the shoe but not point it much, or, it must be done with the inner web of the shoe resting over the horn, battering the web of the shoe,

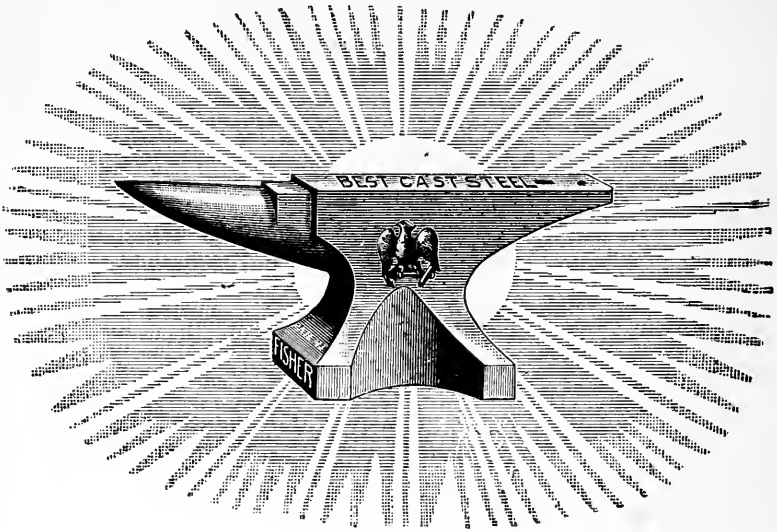


Figure 25 "Eagle" Anvil

which should be done by no one. These inconveniences are done away with in my anvil. Ask your jobber for an "Eagle" anvil, and the "Holmstrom Pattern," and you will get an anvil that will please you. These anvils are made with or without the toe clip horn.

CHAPTER XIII.

INTERFERING

Interfering is a bad fault in a horse, and is mostly found in some horses predisposed thereto from a variety of causes, such as malformation in the feet, the feet being abnormally developed, resulting in pigeon-toe; the planting of the feet outward, or other unnatural positions and movements due to unshapely feet. In other horses the legs are the cause of interfering. They are either crooked, or they are not upright and straight. In others it is the chest which is at fault. The chest is thin, and this brings the legs so close together that the least unevenness of the ground will cause a little variation of the motion which brings the foot against the fetlock, the shin or the knee, and the forward-going foot strikes the other, causing pain or an open sore. Another cause is due to weakness in the legs, or to swollen fetlocks. In others it is due to a peculiar swinging motion in the feet. Any horse may interfere if not properly cared for. A horse shod with heavy shoes will interfere, so will a horse shod with too wide shoes. Some horses will interfere after they are driven twenty miles. Then the horse begins to get tired and cannot take care of his legs properly. A horse, poor in flesh, is liable to interfere. In interfering, the horse brushes the foot going forward against the other foot. Some horses strike above the fetlock, but in most cases they strike the fetlock. When the point of contact is higher than the fetlock it is called

"speedy cut," "knee knocking," "paddling," "cross-firing," etc.

Colts seldom interfere before they are shod; after that they sometimes interfere, because the shoe is either too heavy or too wide — probably both — but the trouble disappears as soon as the colt is accustomed to shoes. To ascertain what part of the foot or the shoe is doing the damage, put a boot over the injured part and paint it white, then drive the horse on a trot, and that part of the hoof or shoe which is doing the harm will show some of the paint. Interfering is common in both hind and fore feet.

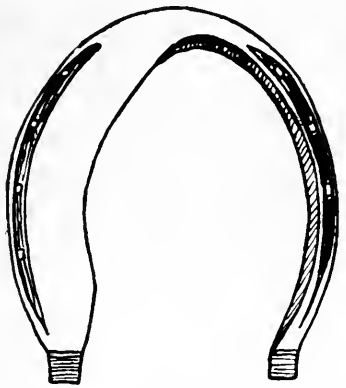


Figure 26

If the fault is in the legs or feet it can be remedied by shoeing. Fig. 26 represents a shoe for interfering. This shoe is called "sideweight shoe." In preparing the foot for this shoe, be sure to make the foot level, and it is well to cut down the hoof as much as possible in order to make the foot as small as you can. Some shoers in shoeing for interfering will pare down the outside edge low, and leave the inside high. This will throw the fetlock out and leave more room for the other foot in passing by; but it is not well for the horse's legs to be thrown out of line that way. (See Fig. 28.) Another will shoe for interfering by putting the shoe well in under the foot on the inside, leaving

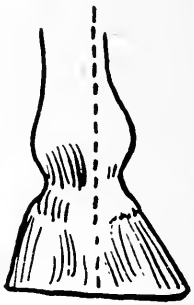


Figure 28

the hoof to stick out over the shoe about a quarter of an inch, and not rasping off this projection of the hoof. This is worse than leaving the shoe outside of the hoof, for the hoof being rubber-like, will, when striking, adhere to the leg more than to the smooth shoe. This method I would call faith cure. Some shoers will make the shoes shorter than usual, and set them well in under the heel, supposing that the injury is done by the heel-calks. This is not so, for the damage is done either with the quarters or the inside of the fore part of the foot. Fig. 30 shows a shoe for this kind of interfering. The striking is not done with the heel-calks unless they project too far beyond the hoof. After the foot has been leveled rasp the hoof straight at the quarters, as shown in Fig. 31, between 1 and 2, or at the front, as indicated by the shoe in Fig. 30. In preparing the shoe remember that the rule is to have the weight on the outside, and the weight should not pass the center, as shown in Fig. 32; for if it does it will neutralize the effect you have tried to produce by placing the weight on the outside. When the shoe is nailed on, be sure to hammer down the clinchings, especially on the inside, for it often happens that these are doing the

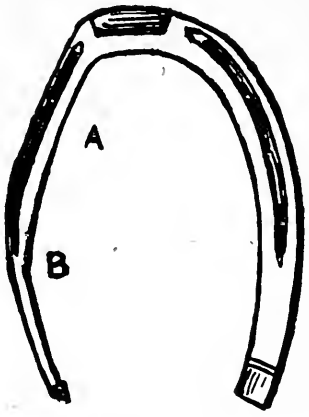


Figure 30

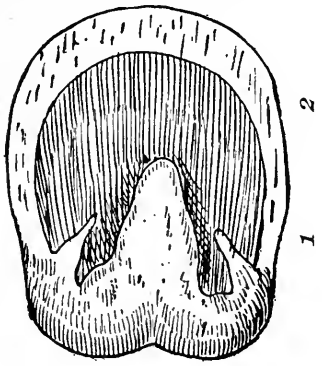


Figure 31

mischief. If the sideweight is heavy enough it will, in a majority of cases, overcome interfering, except in

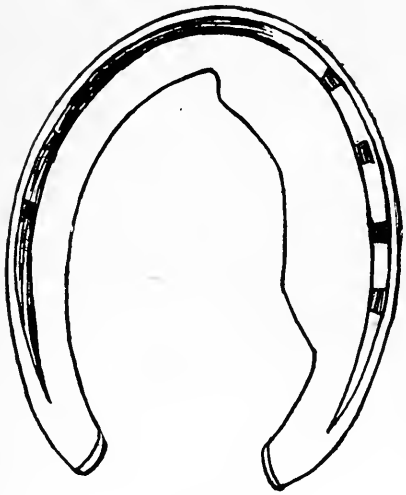


Figure 32

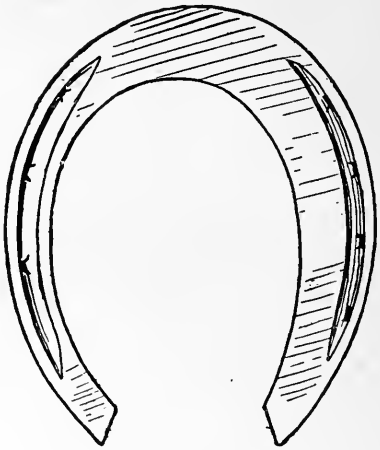


Figure 33 Sideweight

cases of weakness, or when the horse has been reduced in flesh. In such cases rest and ground feed are the best remedies. Nothing is better in such cases than flesh; it is the best leg spreader.

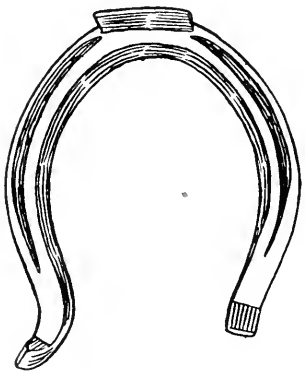


Figure 34

For a horse with a swinging motion in the feet, a shoe as indicated in Fig. 34 should be used. The turned out heel will prevent that swinging motion if there are sharp calks, as shown in Fig. 34. In interfering, a self-inflicted blow produces sores or horny patches on the place of contact. The blow is of different characters, ranging from a light touch scarcely noticeable to a blow that will lay open the part struck and force

the horse to walk on three legs for a while or stand still. The first thing, therefore, to do is to apply a boot to protect the sore and give it a chance to heal. Next proceed to remedy the fault by shoeing, if the animal is young; if old, provide rest and ground feed which will strengthen the horse so that he can carry his feet properly. If it is a bad case of interfering put on a heavy sideweight and a high calk on the inner web, but no calk in front or on the outside. This will break the gait of the horse, and then the calk can be lowered a little at a time until the foot stands level.

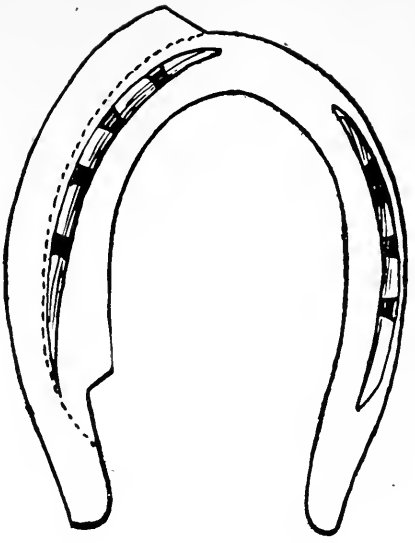


Figure 35

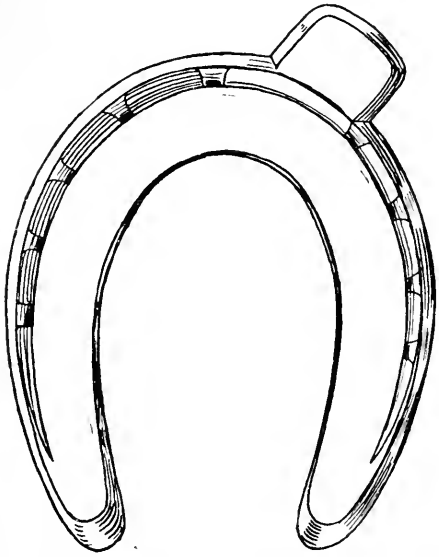


Figure 36 Shoe for Knee-knocking and Pigeon-toe

SPEEDY CUT

Speedy cut is known under different names, which have already been explained. This fault is so much related to interfering that the remedy in some cases is the same. In speedy cut the injury is higher up on the leg. In all such cases the shoer

must aim to change the gait. Sideweight or tit shoes must be used to accomplish this. Fig. 35 illustrates a shoe with the sideweight outside of the edge of the hoof, the dotted line indicating how far the foot extends on the outside.

In speedy cut, the horse breaks over either on the inside or outside of the toe of the foot, and the shoe should be so adjusted that the horse is forced to break over in the center. If, therefore, the horse breaks over on the inside of the toe, a tit shoe should be used with a tit from one to two inches long. Fig. 36 illustrates a shoe of this kind. This shoe can be made with the tit either on the inside or outside of the toe as the case may require. If the horse breaks over with the toe in, put the tit on the outside, and vice versa.

CHAPTER XIV.

SHOEING WITH TIPS

Toe tips are mostly a fad. It is only in one case these shoes should be used, and that is in shoeing for contraction; but even then they are of little value, for if the heel, which is thinner, can stand the wear and tear, certainly the toe can. If in such a case the toe is poor the heel cannot be strong. In using tips the toe must have walls high enough to let the tips down, for in using these plates there must be a notch cut in the wall to receive them, and when the wall is

Figure 37 Buffer

high enough to be cut into for the tip, it is also strong enough to stand more wear than the weak heels. If a horse shod with tips is used on hard roads it will not be long before the heels are low and the toes high, thereby straining the back tendons. For contraction something else than tips must be used—an open bar shoe for instance, although no shoe at all is still better. If

tips must be used in order to satisfy some enthusiast they should be made light, not over $\frac{3}{16}$ of an inch thick, and then they should be set over often. Tips may also be the cause of seedy toe and quarter cracks, because of the notches made in the wall to receive these improper irons.

HOW TO SHOE A TROTTER

Many owners of fast horses are very slavish to fashion. The latest! the latest! they demand, and no matter how injudicious. Somebody starts a fad and it goes the round We hear so much about great improvements in horseshoeing, and it is to a certain extent true, but there is danger in overdoing it. The whims are liable to outnumber the sensible ideas, and I hope the day will come when a reaction will set in, and when it does come we shall see horses race bare

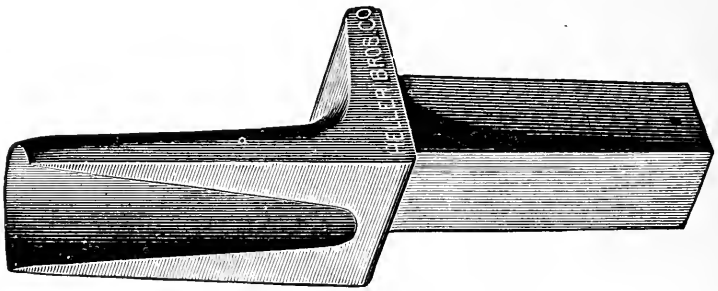


Figure 38 Half-round Hardy

footed, which will be a great improvement over many fatuous notions which are attracting so much attention at present. If we could learn how to raise horses with strong hoofs we would really have learned something. But we will never get strong hoofs in our horses by artificial living and shoeing.

One of the most irrational whims is toe weight,

whether it is in the shoe or in a weight on top of the toe. Nothing is more absurd than those slabs of bar iron, called toe weight shoes; but the whim demands this shoe, and the manufacturer, as well as the farrier, is ready to accommodate those laboring under the delusion. A man with the toe weight whim in his head is deaf to all reasoning on the subject. He will listen to nothing but toe weight. In his mind it is a cure-all, and he imagines that his horse could not get out of the stable without these irons. The tip is another whim A man staggering under the weight of this fad would never think of entering a race without these faith-cure irons under the feet of his horse. I have even heard persons infected with the toe tip craze claim that toe tips would cure contraction, quarter cracks, corns and sprains, and, in short, that they would cure every ill the foot of the horse is subject to. The reason for this shortsightedness is twofold. First, selfishness; when a selfish or small-minded man makes a change in something it must be made to appear as important as possible. Second, most men are of one idea. When they get an idea in their heads there is no room for another. The bar shoe whim is bad; yet there are many points in favor of the bar shoe A bar shoe properly made and wisely applied will do much good, but on account of this fact it is easy for enthusiasts to exaggerate its usefulness.

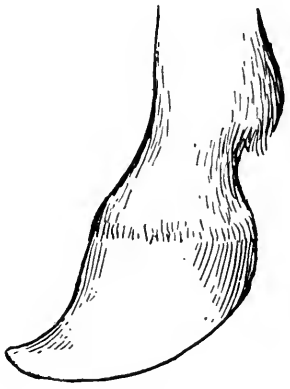


Figure 39

One result of toe weight is laminitis, the result of which is a turned-up toe. Fig. 39 represents a foot

that was ruined by toe weight. When the owner of these feet was three years old there was not a sign of any deformity. The owner of this horse caught the toe weight craze and he got it badly too, for he was not contented with a toe-weighted shoe, but also put on the obnoxious weight, which is sometimes fastened on top of the toe. (See Fig. 40.) The result was that this promising horse became a cripple in two years, with a turned-up toe (see Fig. 39). And what else could be expected—a slab of iron under the toe, a weight of lead on the top of it, the horse put on hard roads to be trained and driven at a high speed that would crush the sensitive laminae in any foot! It is surprising that the result of this fad is laid to other causes and not to the real one. Still, it is useless to object, for oh, how little we know when these "great" horsemen bring a horse to us to be shod! We may have ironed horses for twenty-five years or more and studied and experimented, but we must appear to know nothing, for these "great" horsemen have heard something from someone, or read something about something, and of course they know it all, and the mechanic and artist of sixty must humbly submit to the wishes and whims of ignorant men and oftentimes boys not out of their teens.

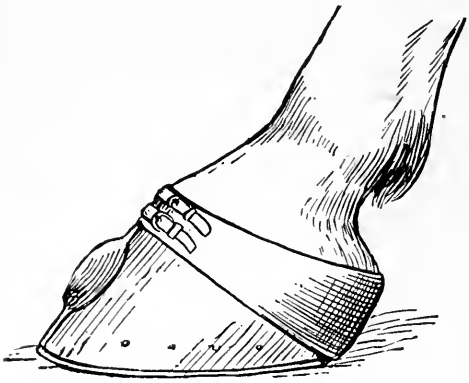


Figure 4 Toe Weight

The first thing to be done in shoeing a trotter is to level the feet.

HOW TO LEVEL THE FEET

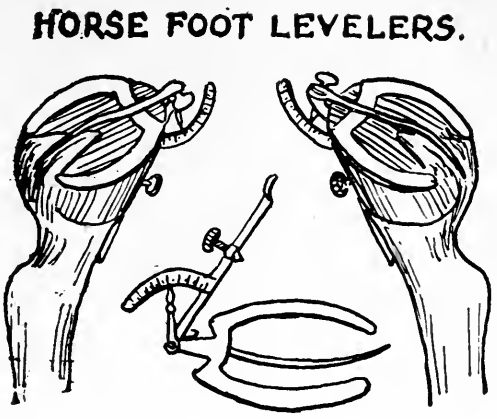


Figure 41

One way, and a simple way, to level the feet is by measuring from the coronet down to the edge of the wall, at the heels and toe, and then marking with chalk to where the hoof is to be pared. No arbitrary rule can be laid down for the angle of the foot; it must be found between fifty and sixty degrees. It is generally the rule that after the right angle has been found the owner of the horse will keep a record of it, and give it to the shoer when the animal is to be shod.

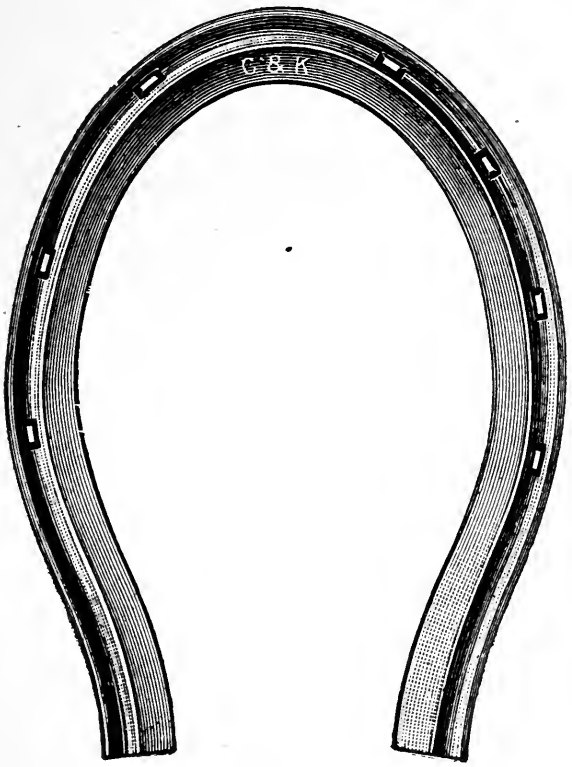


Figure 42

For leveling and finding the right angle, a foot leveler is sometimes used. (See Fig. 41.) It is comparatively easy to

find the angle with such a leveler, but for finding the level they are useless. The foot being level, there is the guide for the making of the shoe. In Figs. 42, 43 and 44 racing plates, as manufactured by the Bryden Horseshoe Company, are represented. Fig. 44 is a light plate, and so are 42 and 43, which it is impossible for any smith to imitate by hand forging. From the cross-section it will be seen that the web is ribbed in such a shape that it is better than calks, and at the same time not so objectionable. I maintain that nothing is more ill-advised than smooth plates First, because they are heavy, and then because they slip more easily than shoes made in the shape mentioned. These shoes are also of a uniformity impossible to attain in hand made shoes. For lightness they will suit every wish, as they come from $1\frac{7}{8}$ to $3\frac{1}{2}$ ounces.

Figure 43

Fig. 43 is the shoe made in what is called Kent's patent. This shoe has a smooth surface at the toe, just enough to weld the calk on, when calks are wanted. The manufacturer of these shoes also makes aluminum shoes, which in heft come near to nothing, weighing only $1\frac{1}{2}$ ounces.

Fig. 42 is a shoe made of ribbed steel, a little heavier than the other and ranging from $5\frac{3}{4}$ to $7\frac{3}{4}$ ounces. These ribbed shoes are of such a construction that no calks are needed. They give a great bearing surface to the foot and a narrow striking surface, preventing concussion, which is greater in a shoe with a wide striking surface. It also gives a sure

Figure 44

grip, which is not the case in shoes with a flat striking surface. This shoe should be fitted to the edge of the wall, so that when the shoe is nailed, there need be no rasping. Use small nails and do not rasp a crease in the hoof under the nails for the clinches, but remove the chip forced out by the nail with a chisel.

Trotters' feet should be kept moist in dry weather with hoof ointment or packing in boots.

CHAPTER XV.

CORNS

A corn is an injury to the living horn of the foot it is very common in horses' feet, and a great number of cases of lameness are due to this trouble. Corns always appear in that part of the foot included in the angle between the bar and the wall of the foot at the heel.

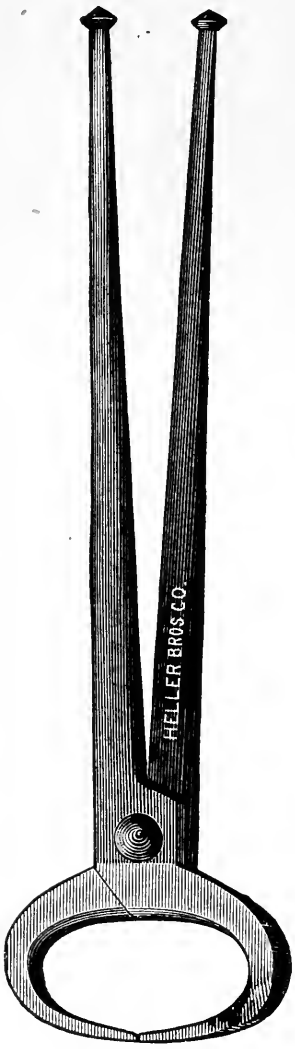


Figure 45 Pincers

In corns the sensitive laminae of the foot are bruised, the capillary blood vessels are ruptured, and a small amount of blood escapes, permeating the horn in the immediate neighborhood, and staining it a dark red color. Of corns three kinds have been recognized: the suppurative, the moist and the dry corns. This division is based on the severity of the result which follows the primary cause.

The fore feet are almost exclusively subject to this disease, and I cannot remember of ever having seen a case of corns in the hind feet. In talking about corns with a veterinarian having a large practice, I asked him if he ever saw a case of corns in the hind feet. Meditating for a while, he an-

swered, "I never did, sir." This is not intended to disclaim the existence of corns in the hind feet. There probably are cases, but they are very rare. This fact should suggest something to a casual observer. Why are not the hind feet subject to corns as much as the fore feet? There are three reasons why they are not. First, the hind feet support less of the heft of the body; second, they receive more moisture and are not dried to the same extent as the fore feet; and third, the heel of the fore foot during progression is first placed on the ground, wherefore it receives more concussion than the heel of the hind foot, in which the toe strikes the ground first. These facts should give the clue to the causes of corns.

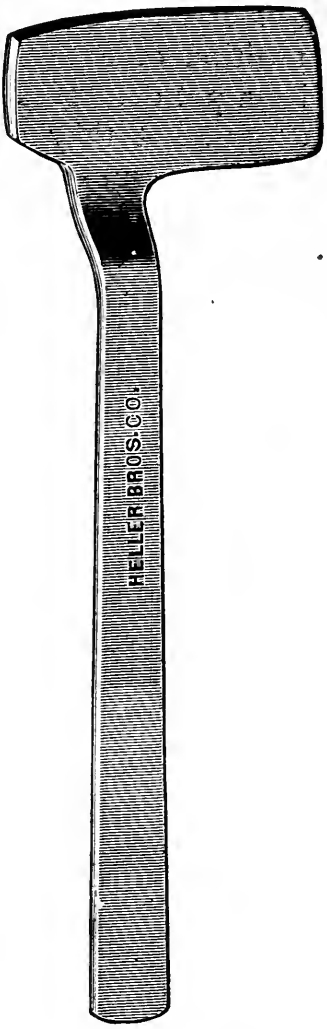


Figure 46 Sole Knife

CAUSES

I do not believe there ever was a writer on this subject who did not attribute the cause of this disease to bad shoeing, and I would not be surprised to some day encounter a work which will settle the whole question of diseases in horses by the sweeping assertion that from toothache to glanders they are all caused by bad shoeing. I make the assertion that there is not a horse-

shoer in the United States so ignorant that he will nail a shoe to a foot with the shoe on the inside of the wall, but no horseshoer is responsible for the position of the shoe three months after the shoe has been put on. It is true that there are ignorant horseshoers, but they are not as stupid as some of the writers claim, and it becomes tiresome to read so many unjust criticisms from would-be wiseacres about the ignorance of horseshoeing, for if their statements were in substance true, the world would soon begin to suspect that all these mechanics were fugitives from some insane asylums. We ought to grant them the sense of ordinary men, and I have found in my practice that if I employ a workman who is doing poor work, the customer will generally make remarks at once, and I hold that the horseshoers are just as sensible, as a class, as any other class of workmen. The horseshoers of the United States should be exculpated from such absurd charges. These charges are mostly made by veterinarians who have never learned the ABC of horseshoeing. I claim that corns are not caused by shoeing, for if they were, every horse that is shod would have them. Neither are they caused by shoes that are claimed to have been on too long, for if that were the case every farm horse would have corns, while it is a fact that farm horses are less subject to corns than other horses. Further, if shoes, good or bad, are the cause, why are the hind feet not equally affected? I have often shod farm horses in the fall and the owner has brought the same horses to my shop in the spring to have the shoes pulled off. I have watched such cases for many years, but failed to find any trace of corns, while horses that had never been shod would have corns. It often happens to horse-

shoers that horses are brought to be shod where the old shoes have been on so long that the shoes will be found imbedded somewhere in the sole, but there will be no corns, either at the time of shoeing or later. The reason that the shoe cannot be the cause of corns is this: when a shoe has become imbedded in the foot in such a manner that it will hurt, the horse will at once go lame. The owner's attention is called to it, and the first thing done is to remove the shoe, and the worst that could have happened is a light bruise, which will heal as soon as the cause is removed.

If there should be a horseshoer so ignorant (and I

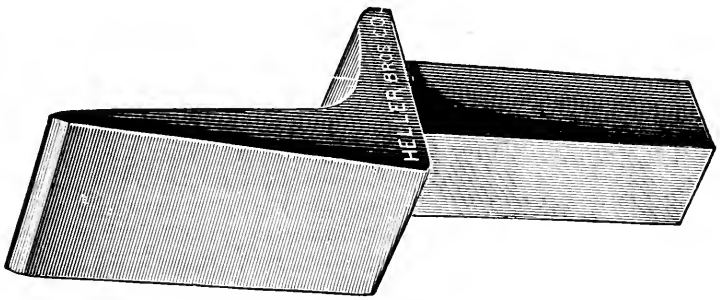


Figure 47 Straight Hardy

do not believe there is one) as to set the shoes inside of the wall, I will venture the assertion that the owner of the horse would not allow it. We will, therefore, be safe in dismissing that charge, and the damage done by the shoes, after they have been on for three months, should be credited to the owner of the animal so neglected.

In Sweden corns are called "stone bruise," but I claim that stones are not the cause of corns either; for if a stone gets wedged in between the wall and the sensitive laminae so as to cause pain the horse will show it at once by limping on the injured foot. The

foot will then be examined and the cause of the lameness discovered. The stone will then be removed, which also removes the cause, and effects the cure.

Figure 48
Blacksmith's Tongs

Figure 49
Horseshoeing Tongs

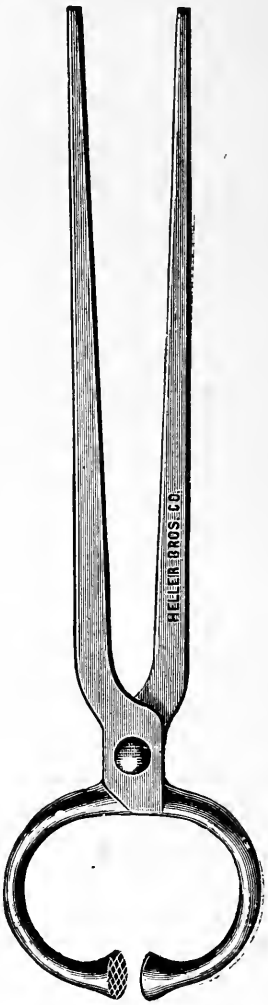


Figure 50
Hoof Tester

Corns are produced by something more obscure than stones and shoes, otherwise they would be more easily cured. Corns on the human foot are different from

corns in horses; but there are cases where the corns in the horse assume the character of a callousness, and they cannot be cured, because the friction cannot be removed. Now then you may ask, what are corns? Corns are the result of a bruise, caused by the friction of the coffin and navicular bones against the sensitive laminae of the foot. The next question is, what causes this friction? First, hard driving on hard roads; second, contraction of the hoof, which causes the sensitive laminae to press against the sharp edges of the coffin and the navicular bones, bruising the sensitive laminae and resulting in corns. All talk of shoeing to cure corns is, therefore, vain. The fore foot being more exposed to dryness, and receiving more of the heft of the animal, is more susceptible to corns. The center of gravity going at the inner side of the foot is the reason why corns, in most cases, are found on the inner side of the foot.

SYMPTOMS

Corns always make the horse lame. There may be intense soreness, as in suppurative corns, or slight soreness, as in dry corns. Old horses, having chronic corns are so much used to the pain that they limp very little, especially if both feet are affected; still such horses are generally restless and move the feet about. In suppurative corns the lameness is soon over if the abscess is opened. In such cases where the injured tissues are much inflamed the heel of the affected side is hot and sensitive, the whole foot, of course, is tender in sympathy. In dry and chronic corns all evidence of local fever is wanting. When corns are suspected the foot should be examined for increased sensibility of the inside heel. Grasp the wall and the

bar with the hoof tester, and if the horse has corns he will flinch. For further evidence remove the shoe and cut with the knife at the seat of the corns. As the sole is pared out in the angle it will be found colored and stained red with the escaped blood. The discoloration in suppurative corns is less marked than in dry corns. In suppurative corns the horn is colored gray or white, stringy and often mealy. The difference between suppurative corns and others is that the inflammation in suppurative corns ends in suppuration. The pus collecting at the place of injury, escapes by working a way between the sensitive and insensible laminae at the coronet. Cases of this kind are serious, for they may cause gangrene. If the disease is caused by fast driving on hard roads there should be rest given, and the feet should be placed in cold water to soften the hoof and to allay fever and inflammation. If the cause is contraction, the feet should be packed in boots to soften the hoofs and give them a chance to spread.

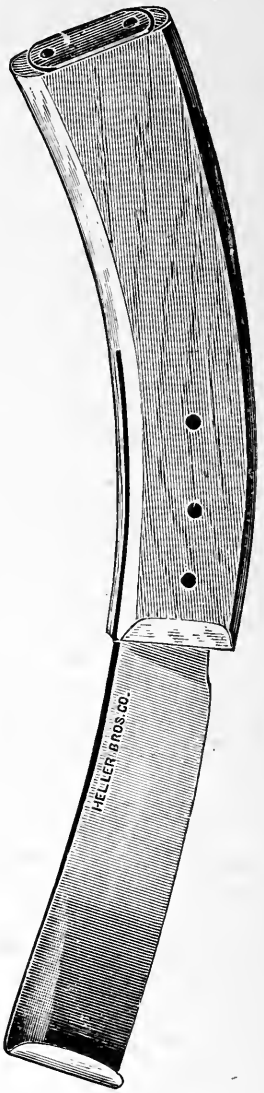


Figure 51 Shoeing Knife

If any of the above causes have produced suppurative corns, remove the loosened sole, so that the pus will freely escape. If the matter has worked a passage out at the coronary band and escapes between the band and the hoof, then

cut an opening on the sole so that the pus can work down. Bathe the feet for a day or two with cold water made astringent with a little sulphate of iron.

If any complications should arise and gangrene set it, it is best to call an old veterinarian. In all cases of corns, packing or poultices should be applied to soften the horn and spread the foot. Moist corns should be cut out, and balls saturated with pine tar put into the hole and changed every day until the corn is healed.

In all cases of corns keep the feet soft. There is no need in cases of dry corns to cut them out. On the other hand it is better to leave as much of the sole as is possible, and not touch the sole, for the dead sole will retain moisture and help to keep the foot soft, which is most important in all cases of corns.

SHOEING FOR CORNS

There is no such thing as shoeing to cure corns. The best that can be done is to shoe to relieve pain.

For moist corns a rubber shoe will sometimes be found convenient as soon as the foot is in a condition to receive a shoe. The wall directly over the corns, as well as the sole, should be lowered so that there will be no pressure over the seat of the trouble. After the foot is healed a half-bar shoe, as shown in Fig. 52, should be used. In using a shoe like that, the bar of the shoe should rest well on the frog, and all bearing over the corns taken off.

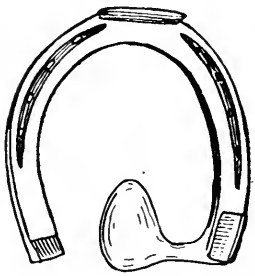


Figure 52 Half-bar Shoe

For moist corns, shoe as for suppurative corns.

For dry corns, and when the horse is to be driven

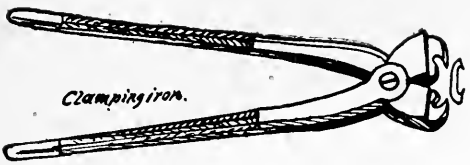
every day, either put on a heavy shoe or a half-bar shoe; the bar to rest on the frog with no pressure directly over the corn. The shoe should have short but sharp calks, and the feet should be packed so as to keep them moist and prevent contraction.

SAND CRACKS

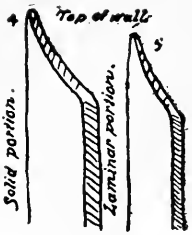
Sand cracks are generally of two kinds: toe cracks and quarter cracks. The toe crack is a crack running from the toe upward, and in most cases up to the coronet; while a quarter crack is on the inside quarter of the foot. The inside quarter is more liable to this injury than the outside, for the reason that this side is thinner, and in locomotion receives a greater part of the weight of the body than does the outside quarter.

The causes of sand cracks are many. Predisposing causes are: hard and brittle hoofs with no elasticity, brought on by poor assimilation and want of nutrition to the hoof; hot, sandy and hard roads, also wet roads, which wash the natural substances out of the feet, making them brittle. Shoes with toe clips, large nails, together with such diseases as suppurative corns, quittor, grease and canker, are also causes of sand cracks. Heavy pulling on hard and slippery roads, fast running and jumping, sometimes blows on the coronet and calk wounds are incidental causes. The lameness of sand cracks is generally slight when the horse is walking, but the trouble is greatly aggravated when he is running.

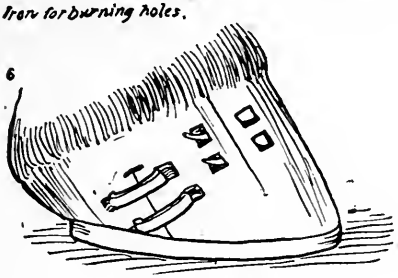
The toe crack closes when the horse stands on the foot, and opens when the foot is raised from the ground. In the quarter crack the opposite is the rule. Preventive measures consist in keeping the hoof



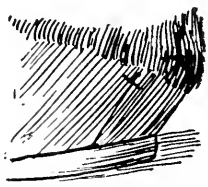
Iron for burning holes.



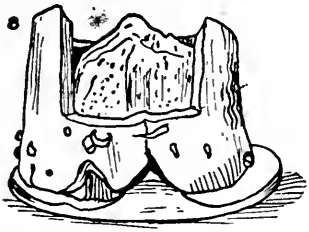
Actual thickness of walls of hoof



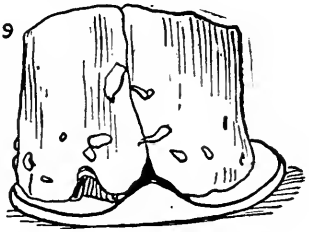
The clamp and nail remedies applied.



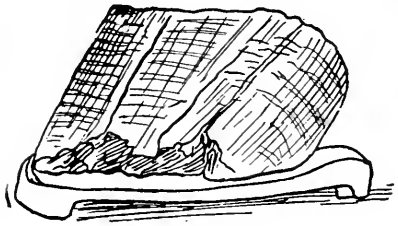
Quarter-crack with cross cut.



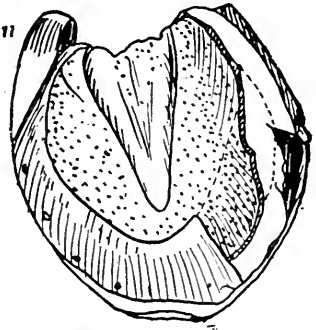
Toe crack. Wall removed to show absorption of coffin bone.



Treated by clamping with nails.



Cracked walls.



One effect of Quarter-Crack.

QUARTER-CRACK AND REMEDIES.

Plate 33

soft by freely using hoof ointment or packing the feet in boots for the same purpose. The evil of jumping and fast driving must also be avoided. When the crack is first noticed means should be adopted to prevent it from growing deeper and larger. This can only be done by arresting all motion in the edges, and for this purpose there are different methods practiced. The Wachette clasp, as shown in Plate 33, is often used with good results. These clasps and instruments are sold by makers of veterinary instruments. The cracks can be closed by nails, as shown in No. 6 of the same plate. A plate of brass or iron can be made and put on with screws, as shown in Fig. 53. In all cases of sand cracks there should be a heavy enough shoe to hold the foot from spreading and a bar shoe with toe clips on each side of the toe for toe cracks, as shown in Fig. 53. The clips should be at the quarters if it is a quarter crack. At the upper end of the crack a cut should be burned across the crack, as shown inFig. 53, to help start the growth of the new hoof. In Fig. 54 a bar shoe is shown, with bands welded at each side of the shoe, and through the ends of these goes a bolt with which the foot can be bolted together, so that the edges of the cracks will meet. This shoe is also

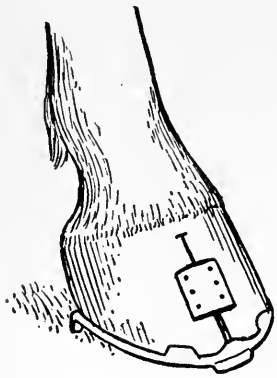


Figure 53
Plate for Sand Cracks

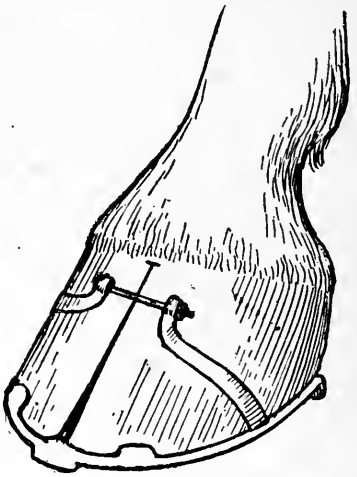


Figure 54
Clasp Shoe for Sand Crack

provided with toe clips, and it is the best shoe devised for sand cracks. If the crack is deep and the flesh projects out between the edges of the crack, let a veterinarian burn it off. In shoeing for sand cracks use an endless bar shoe, to prevent the foot from spreading. The shoe should also have sharp calks to prevent concussion and jars.

CHAPTER XVI.

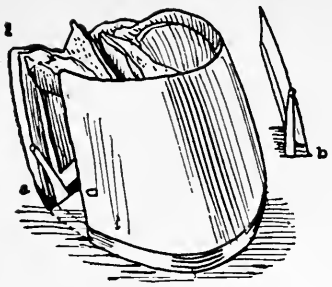
CONTRACTION

Contraction is not in itself an original disease. It is, in most cases, the result of other diseases and of artificial living. Before the colt is used for work and shod, his hoofs are large and open-heeled. The quarters are spread out wide, and the foot on the bottom is like a saucer. The reason for this is found in the fact that the colt has been running on the green and moist turf without shoes, and the feet have, in walking in mud and dampness, gathered so much moisture that they have spread at every step. This is changed when the colt is taken out of pasture, put on hard roads, and stabled in a stable with hard and dry floors, where the feet become hard and dried up.

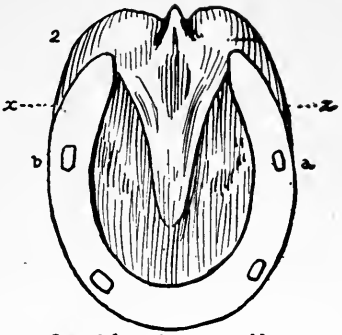
Contraction follows sprains of the tendons, corns, founder and navicular disease. When contraction is found in only one of the feet, it is generally the result of a disease in the foot, because the horse will stand on the healthy foot, which receives more pressure and is spread out, while the diseased foot is dried up and contracted. In such cases the feet become uneven and do not look like mates.

No man can comprehend the suffering of a horse when his feet are hoof-bound and pressed together as if they were in a vise. The pain from a pair of tight and hard boots on a man is nothing compared to the agony endured by this noble animal and silent sufferer. Contraction seldom, if ever, affects the hind

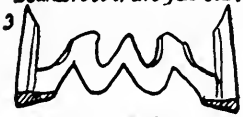
1, 2 and 3, Sound foot of two year old.



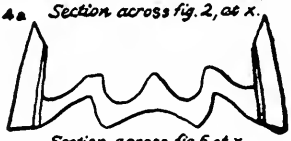
a, Nail properly driven.
b, Nail improperly driven.



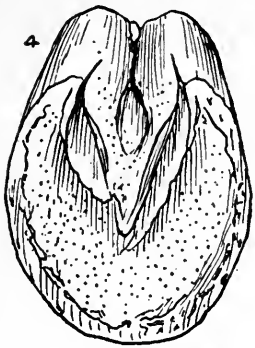
Sound foot of two year old.



4a Section across fig. 2, at x.

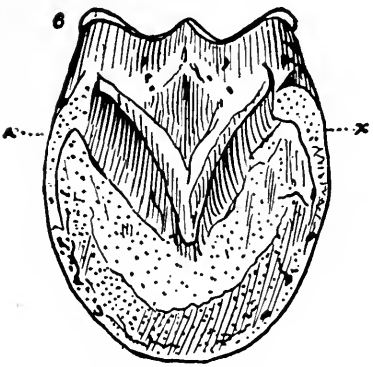


Section across fig. 6 at x.

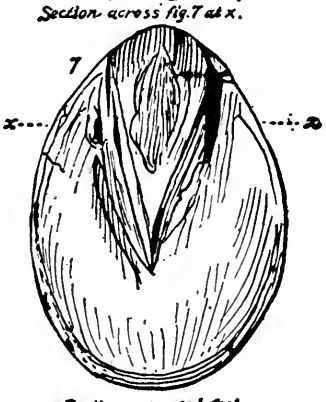


Contracted foot

Section across fig. 7 at x.



Sound but flat foot.



Badly contracted foot.

SOUND AND CONTRACTED FEET.

Plate 34

feet. This fact should be suggestive. Why do not the hind feet become contracted? Because they receive more moisture, and consequently do not dry up and become as hard as the front feet. From this fact we may conclude that there is no such a thing as shoeing to cure contraction; still, if the horse must be shod in order to work, the shoeing should be done in such a manner as not to increase, but on the contrary to alleviate the trouble.

Some horses are predisposed to contraction. A high heel, perpendicular in growth, sometimes narrower at the ground surface than at the coronet, is predisposed to contraction. (See Nos. 4 and 7, Plate 34.)

SHOEING

Pull off the old shoes, pare down the feet as much as can safely be done, but leave the frog as large as it is. Then have the feet put in a warm poultice for twenty-four hours, or in a packing of wet clay. In preparing the foot for the shoe pare down the heels so that there will be no contact between them and the shoe, especially if the hoofs are narrower at the bottom than they are at the coronet. Next prepare an open bar shoe, as shown in Fig. 55. Nail this shoe on with the six front nails leaving the hind holes empty, and let the shoe or bars rest well on the frog. Keep the feet soft, either in packings or with hoof ointment or both, and as soon as the foot is soft it will spread from the effects of the horse standing on the frog. The shoes should be reset often, and when they are

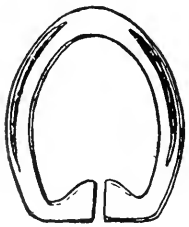


Figure 55
Open Bar Shoe

nailed, the nail should be started at the inner side of the nail hole; this will spread the hoof all that it will stand.

Nothing is more undesirable than an endless bar shoe, with holes clear back to the heels, as is used by many. The foot, being nailed to it, cannot spread. It is closed in with an iron band, which renders it impossible for the foot to spread, it deadens all frog pressure and, still worse, it compels the foot to crimp, as it must grow inside of its limit downward instead of growing outward. If any disease is caused by shoeing, it is contraction, for all shoes, no matter how they are made, will interfere with the expansion of the hoof and raise the foot from the ground, giving the air a chance to play under the sole and dry the foot. If calks are put on, they should be as short as possible.

If the frog has become hard do not put on a bar shoe with frog pressure, for it will not do much good, but rather harm. The only remedy for contraction is moisture. The disease is brought on by artificial living, in which the foot has been deprived of the moisture necessary to keep it healthy. Bring the foot back to that natural condition in which it was originally and contraction is cured. Any packing or hoof ointment used so as to soften the foot will accomplish this.

Many shoes and devices have been made to spread the feet, but nothing is more injurious. I will not spend any time trying to explain these different makes and kinds of shoes, for they are of no value but on the contrary will do great injury to the horse. We may imagine the pain to the horse by stretching the dried wall out from the sensitive laminae of the foot. This will tear asunder but not spread the foot. No, the spreading must be natural and slow. Soften the

foot and the foot will spread at every step the horse takes, as the foot receives on an average a thousand pounds' pressure in every step, and if that is not sufficient nothing else will do it.

Shoes are also made with the web of the heel slanted out; the intention being that the foot shall spread from the heft of the horse as just described, and it will do so provided the foot is wider at the bottom than it is up at the coronet, and if not wider it will not spread very well. But this spreading will only bruise the sensitive laminae, if the foot is not prepared by a good soak before the shoe is put on, and kept in that condition while such shoes are used. I maintain that the frog is the best wedge to spread the foot with, if the foot is only kept in such a condition as to permit this natural foot expander to accomplish the object for which it was placed there. The best shoes for contraction are no shoes at all, but a long run in a wet pasture instead. Horses with feet predisposed to contraction should be subjected to a preventive treatment. An occasional poultice of boiled turnip, linseed meal, or the use of some good hoof ointment, will prevent the foot from crimping.

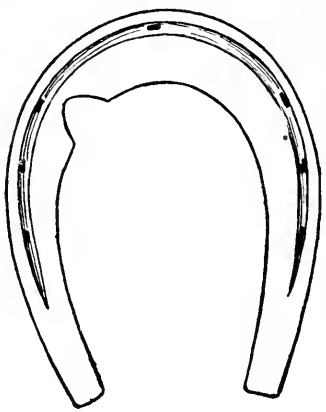


Figure 56
Shoe with Groove to Give in Spreading for Contracted Heel

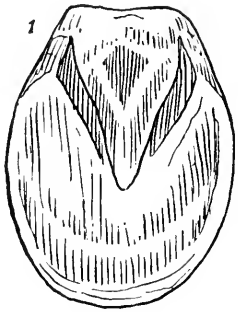
When contraction is the result of some disease the treatment must be directed toward curing the disease. If the inside heel has been contracted so as to be bent under the foot, a shoe, as shown in Fig. 56, can be used, and the groove in the shoe should

be on the same side of the foot as the heel which is contracted. This shoe can be spread a little at a time with a pair of tongs. But it should be remembered that no spreading should be done before the foot has been softened. The groove in that shoe will cause the grooved side to expand. The spreading should be done with great care and very little at a time.

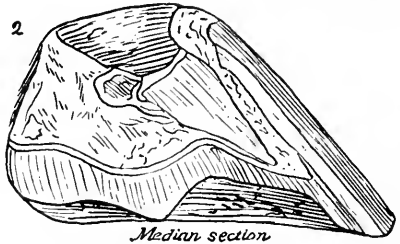
LAMINITIS

Laminitis is generally known to the farrier by the term "founder." Laminitis is an inflammation of the sensitive laminae of the feet, destructive to the tissues affected.

The causes of laminitis are many. The most common causes are exhaustion, over-exertion, concussions, rapid changes in temperature, indigestion of various foods, and purgatives. Concussion is the cause of laminitis when the horse is driven at a high speed when in a condition unfit for such exertion, and it is the more easily brought on when a weight is placed on top of the foot, called toe weight, causing the foot to be thrown out against the ground with force. The toe weight in the shoe is also productive of the same result, but not to the same extent as is the weight on top of the foot. A horse taken from the farm and driven hard on macadamized roads or paved streets is liable to contract such inflammation. Long drives and heavy pulling are often the causes of this disease. Horses on sea voyages will be affected by this trouble. the exhaustion of the laminae resulting from the continual strained position in which the horse is compelled to stand on account of the rocking motion of the ship. Rapid change of temperature is another

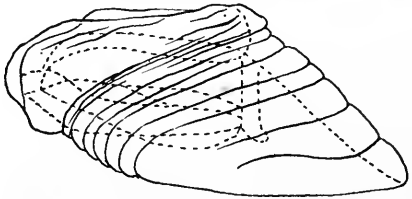


Foundered foot

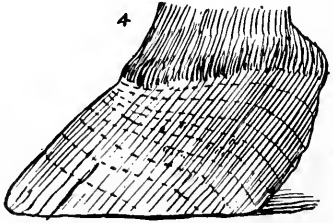


Median section

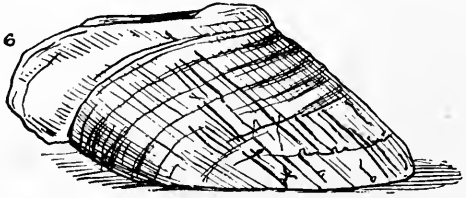
Median section.



Skeleton of hoof showing cavity occupied by the foot



Same foot as shown in fig 1.



Same foot as shown in fig. 5.

Bottom of foot shown in fig. 6.

FOUNDERED FEET.

Plate 31

cause, such change being induced by drinking cold water while in an overheated condition, or from cold winds—the horse being left in a cold and windy place when wet with sweat.

It is claimed that barley, wheat and corn are productive of this disease in some horses. When one of the feet is incapacitated from any cause the other foot is called upon to do double duty and is soon exhausted, and congestion, followed by inflammation, results. When one foot only becomes laminitic, the other member will be affected later, not from sympathy but because this member is doing the work of two.

All old authorities agree that metastatic laminitis is a reality, while many of our modern writers deny this. In cases of chronic laminitis it is found that the toe of the foot turns up, the heels are longer than natural. The cause of this may be ascribed to the fact that the coronary band in front produces horn very slowly, while in the heels the production is greater. The result is that the hoof is creased like the horn of a ram. These creases or ridges are also found in other diseases of the foot, but they are then equally distant from each other all around the foot, while in laminitis they are found to be wider apart at the heels and closer together in the front. (See No. 4, Plate 31.)

Laminitis is a dangerous disease and the farrier is not expected to do more than shoe the animal so as to minimize the jar and concussions. When the horse is excessively lame in one foot, remove the shoe from the other member and apply cold water frequently as a tonic to prevent laminitis in this foot from too much strain. If the horse remain standing, place him in the sling so as to relieve the pressure in the feet. (See Plate 28.) In severe cases, with profuse suppura-

tion of the laminae, it is best to destroy the animal and end the suffering.

In chronic cases where the horse is used for work, shoe with light shoes and sharp but short calks. If the horse shows lameness and tenderness use rubber shoes. The hoofs should be kept soft to prevent contraction which would greatly aggravate the trouble.

PUMICED SOLE

Pumiced sole is also known by the term drop sole. By this is meant that condition of the foot in which

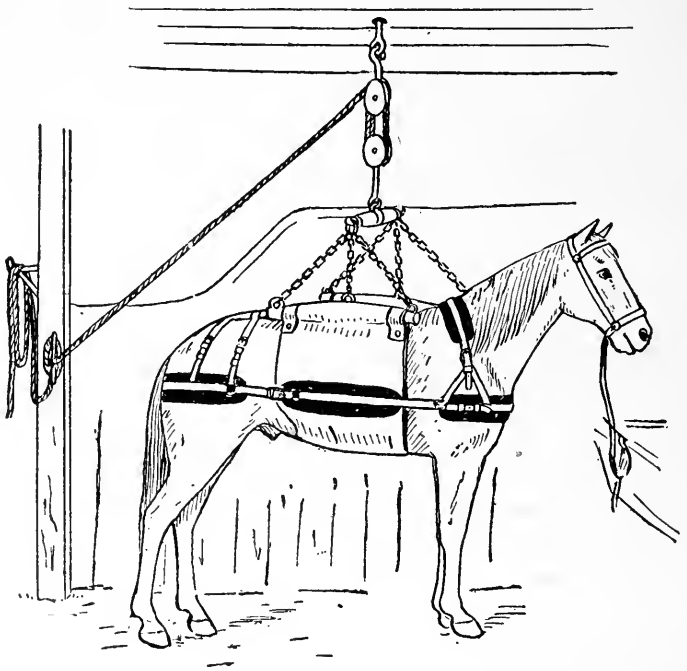


Plate 28

the horny sole, especially at the toe, crumbles away, leaving the sensitive tissues more or less exposed. It is often the result of laminitis, but may be seen when the conditions necessary for inducing it are present.

The horny tissues become weak, cheesy or spongy. When the soft tissues are destroyed it often happens that the horny sole crumbles away under the pressure of the coffin bone, and the end of the bone comes out through the sole. In this disease the sole becomes convexed and it is a hard matter for the farrier to fit a shoe to the foot, as the wall is not even with the sole, but much shorter than in the healthy foot. In such cases I would recommend rubber shoes. In preparing the foot for the shoe, shorten the toe of the foot as much as possible. The foot being long there is danger of the coffin bone breaking through; for the longer the foot the harder the pressure of the bone against the sole. The sole should not be pared off any, for it is thin enough as it is. This kind of cripple is generally incurable unless the trouble was brought on by a puncture or wound, in which event a cure may be effected when the wound is healed.

CHAPTER XVII.

HOW TO SHOE A FLAT-FOOTED OR WEAK-HEELED HORSE

In shoeing horses it is often the case that some horses go lame as soon as the shoes are put on, and the horse is all right as soon as the shoes are pulled off again. In examining the feet of such horses it will be found that there is a weak low heel. Weak-heeled horses have, as a rule, wide flat feet, low heels, soft and sensitive balls. The reason why a horse with this kind of feet goes lame when shod by the average shoer is twofold. First, the shoe is allowed to rest too hard against the weak heel; second, the nails have been tightened too hard, drawing the flat foot down against the shoe and causing pain in the tissues connecting the horn with the sensitive laminae of the foot.

In shoeing, make a shoe with a heavy web, and set it so that there is no bearing on the heels. Do not draw the clinches hard. The shoes should have sharp calks to take up the jar and prevent concussion. An open bar shoe with some frog pressure can, in this case, be used with advantage.

Flat foot is not the same as "drop sole." This is another thing entirely, and is termed "pumiced sole," under which head it is treated in another chapter. Many kinds of shoes are made even for flat foot. Some have springs in them to rest on the frog, but they are not practical, and sometimes they cost more than the horse is worth. It takes more time to make

this kind of shoes than both the smith and his customer can spare, and when it is made it is only a cunning device, good for little or nothing, that will last for a month and then it must be made over again, which repeated performance the horse owner soon tires of. It must be a horse worth a thousand dollars to be worth the trouble of making such shoes. What we want in this case as well as in all other instances, is a practical shoe, easy to make and cheap enough for any horse.

HOW TO SHOE A HORSE WITH BRITTLE HOOFS

On heavy draft horses with brittle hoofs it is difficult to place the shoe so that it will stay on for the required time. The reason why the shoes come off is the brittle condition of the hoof, which breaks out in pieces, or else the nails pull out through the holes, which wear large. In such cases a shoe with toe clip should be made. The shoe should be fitted snugly to the foot. When the foot has been prepared and the shoe made, heat the shoe all over to a red heat, then press it quickly to the foot. This will give the shoe a perfect bearing which is essential in every case, but especially with brittle hoofs. Drive the nails deep to get good clinch holds.

STRINGHALT

Stringhalt, or springhalt, as it is sometimes called, consists in a spasmodic jerk in the hind legs, sometimes only one leg being affected. In some cases the jerk is more violent, the foot striking against the belly. In others the jerk is only a few inches high from the ground, but always the same spasmodic jerk. In some cases it will only be noticed when the horse is

backed out of the stable, in others it is worse when the horse is started. Then he will jerk first one foot up and then the other and so on for a while, but when once started he will walk all right. There are different opinions in regard to this disorder, but the majority seem to be in favor of the belief that it is a nervous disorder. There is so far no cure known for it. If it is a local disorder in the leg, bathing the quarters once a day in cold water for two weeks may alleviate the jerk. If not, try warm water. Rub the quarters dry after bathing.

STIFLE

The displacement of the patella is generally known to horseshoers as "stifle." In cases of this kind an experienced veterinarian should be called, as mistakes are often made in regard to this trouble. Cramps of the muscles of the thighs are sometimes taken for stifle. The displacement of the patella may occur in many different ways, as by falling, or slipping in rising in the stable. In most cases the cause is weakness and general debility, and in some instances it is brought on by lack of exercise.

When a stifled horse is brought to the shop for shoeing, I would advise the farrier to first try the following method, and if it fails to bring the stifle back, the animal may be shod for stifle: Tie a rope around the ankle of the affected leg and pull the foot forward; now hold the foot in this position while one man pushes the horse over from the opposite side, so as to make him stand on the stifled leg, at the same time a third man should place his hands on the stifle and push it forcibly inward, and at the same time forward, so as to force the stifle back. If this manipulation is

successful there is no need of shoeing the stifle. If it is not, proceed to shoe as follows: Make a shoe as shown in Fig. 57. This shoe is intended for the foot of the well leg. It will be seen from the shape of this shoe that the intention is to put on a shoe that the horse cannot stand on. The horse is then compelled to stand on the stifled leg, pressing the stifle back with his own heft. As soon as the stifle is back in its place remove this cruel shoe.

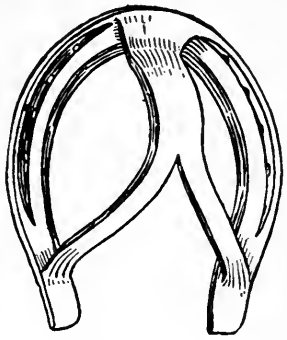


Figure 57

As soon as the stifle is back in its place the horse will seem to be all right, and the animal may walk or trot without any sign of lameness. The trouble may, however, return at the slightest provocation, the muscles being weakened it comes on easier after each performance, and the trouble gradually becomes a habitual weakness.

SEEDY TOE

Seedy toe is a dry rot at the toe of the foot, extending up between the wall and the laminae. It is caused by hot dry roads, or striking the toe against the pavements. It is sometimes the result of toe clip in the shoes.

Remove the shoe and pare away any dry and mealy substance. Cut down the toe so as to take away all bearing from the toe against the shoe. Apply hot pine-tar, and fill the hole with a wad of tow dipped in the tar. The toe clips should be cut off, so that there will be no rubbing against the toe.

PUNCTURED WOUNDS

Pricking, or punctured wounds, are very common, and probably the most serious injury to the foot. Horses are pricked in many different ways: by nails, slivers, sharp stones or anything that will penetrate the sole and injure the foot. This trouble is more dangerous in the center and fore part of the foot than in the heels.

Figure 58 Bi-treadle Grindstone

If the horse is pricked by shoeing, pull the shoe off and examine the nails. The nail which has gone into the quick and caused the damage is generally wet and a bluish color. If this pricking has been deep, the

first evidence of its existence may be the discharge of pus at the coronet. In such a case the place of pricking should be located and the horn cut away so as to give the pus a chance to work down. When the diseased parts have thus been exposed, the foot should be put in a boot of linseed poultice for a day or two, until the lameness and suppuration have disappeared. If the horse has been pricked so deep that the coffin bone has been injured, serious complications may follow.

Cutting the horn away will often be found a difficult task with such tools as are at the command of the farrier. The foot being very sore the cutting must be done with a sharp knife. Most horseshoers sharpen their tools with a file. This makes a rough edge, which will neither work easy nor cut keen. Every shop should be equipped with one of the Cleveland Stone Company's bi-treadle grindstones. (See Fig. 58.) Even for ordinary shoeing the work is made easier and the workman who keeps the best tools is the one preferred.

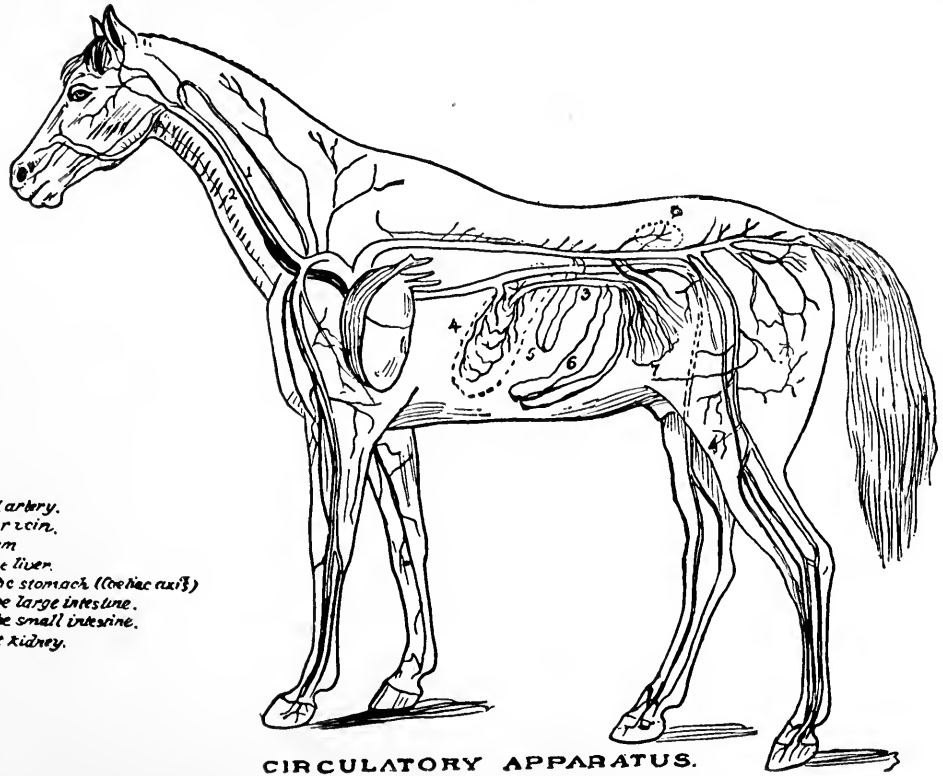
In shoeing for pricking, use rubber shoes until the foot is sufficiently healed to stand iron shoes.

CHAPTER XVIII.

KNEESPRUNG

Sprung knees is the result of some disease not yet understood. We often find a horse with straight legs who will, without any noticeable cause, begin to set his knees forward, and in the course of a year or two the animal will have become totally useless.

It was the custom of all old writers to accuse the horseshoer of being the source and fountain from which all the diseases of the horse's foot sprang; and it is a wonder that the horse has not been annihilated long ago, or at least all crippled beyond redemption. Even this disease has been attributed to the criminal stupidity of the farrier. I am happy to note that a change in this respect has begun to set in, and I will here quote Prof. A. Leautard, M.D., V.M. The professor says in his report to the Agricultural Department, Bureau of Animal Industry: "Sprung knees, though not positively the result of diseases of the tendons acting upon the knees, we venture to consider this deformity in connection with that which we have just discussed — knuckling fetlocks. It consists in such an alteration in the direction and articulation of the bones which form the various carpal joints. Instead of forming a vertical line from the cannon bone, they are so united that the knee is more or less bent forward, presenting a condition due to the retraction of two of the principal muscles by which the cannon bone is flexed. This



Heart :

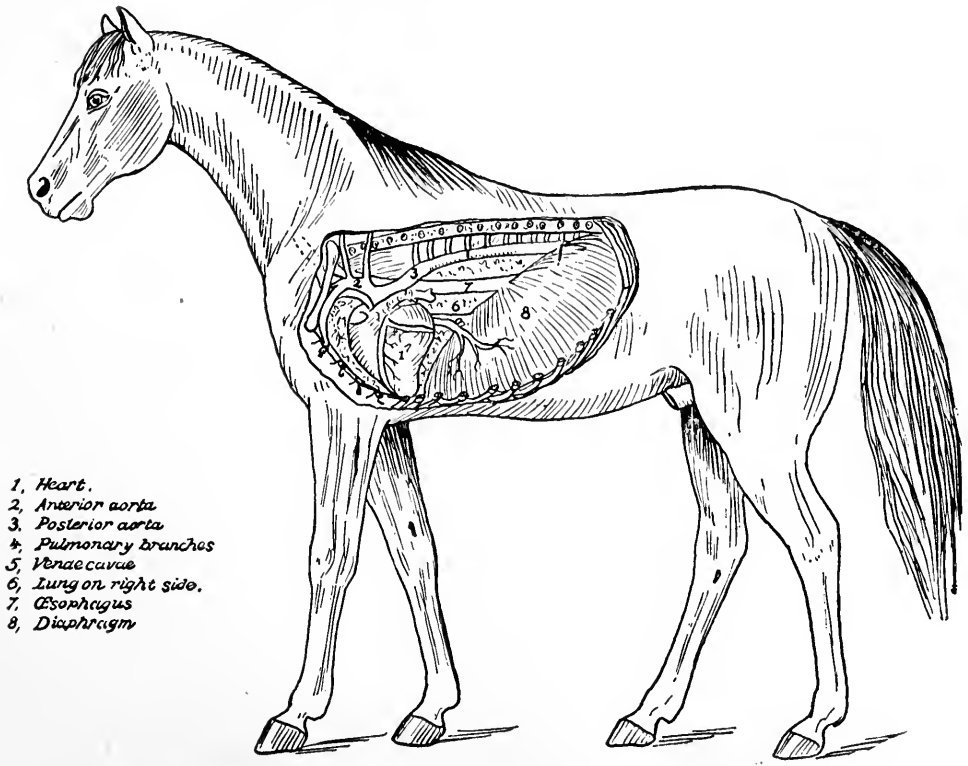
1, Left carotid artery.
2, Left jugular vein.
3 Portal system
4, Vessels of the liver.
5, Arteries of the stomach (Coeliac axis)
6, Vessels of the large intestine.
7, Vessels of the small intestine.
8, Artery of left kidney.

CIRCULATORY APPARATUS.

Plate 18

flexion of the knee may also be a congenital deformity and have continued from the foaling of the animal. Or, like clubfoot, it may be the result of heavy labor which the horse has been compelled to perform at too early an age It may also be due to other diseases existing in part below the knee joint. Whatever may be the originating cause of this imperfection it detracts very largely from the usefulness and value of a horse, disqualifying him for ordinary labor and wholly unfitting him for service under the saddle without jeopardizing the safety of the rider. If, however, the trouble is known from the start, and is not the result of congenital deformity or weakness of the knee joint, or secondary to other diseases, rest, with fortifying friction, may sometimes aid in strengthening the joints; and the application of blisters on the posterior part of the knee, from a short distance above, to a little below the joint, may be followed by some satisfactory result. But with this trouble, as with knuckling fetlocks, the danger of relapse must not be lost sight of, but kept in mind as a contingency always to occur."

From the above we learn that it must be something else than bad shoeing which has caused this deformity. A horse with sprung knees is liable to become weak and debilitated from want of rest, and the strain enforced on the animal in order to stand. It will be noticed that a kneesprung horse cannot sleep standing, for he will fall as soon as he goes to sleep. In a straight leg the center of gravity is down through the center of the leg and out at the heels. This is changed in a case of sprung knees. Here the center of gravity is through a line forward of the suspensory ligaments and the result is that the horse must stand



INTERIOR OF CHEST SHOWING POSITION OF HEART AND DIAPHRAGM

with an effort to hold the legs from doubling under him; hence it is tiresome to stand, and the horse will get worse and weaker.

There is very little for the horseshoer to do in such cases. Shoes with high heels may relieve some of the strain on the back tendons. Showering with cold water several times a day for a week or two and rest in the pasture may help.

HOW TO SHOE A VICIOUS HORSE

Shoeing kicking horses is both dangerous and hard labor. It is no use for a man to wrestle with a horse, as we now have so many different kinds of devices for handling vicious horses that any shoer can have at least one, and even several of them, at his disposal for a nominal cost.

One simple device is the twist. A twist can be made of a piece of a broom handle two feet long. Bore a hole in one end and put a piece of clothes line through, so as to make a loop six inches in diameter. Put this loop over the lip or the ears of the horse, and then twist until it hurts enough to give him something else than the shoeing to think of. This simple method will help in a majority of cases. Should the twist prove ineffectual, make a leather strap with a ring and buckle. Buckle this around the foot of the horse, tie a rope in the ring; next braid a ring into the tail and run the rope through this ring and back through the ring in the strap at the foot. Now pull in the rope. (See Fig. 59.)

In this device the horse will hang with his leg in his tail, and although he may make some efforts to get loose in the start—probably throw himself—he will soon submit and in most cases never move a muscle.

I have not yet had a case where I did not conquer the beast with this apparatus.

Another device is the sling. (See Plate 28.) When the horse is ready to be raised, tie a rope around the foot to be shod, and when the horse is raised pull in the rope and the foot is easily managed.

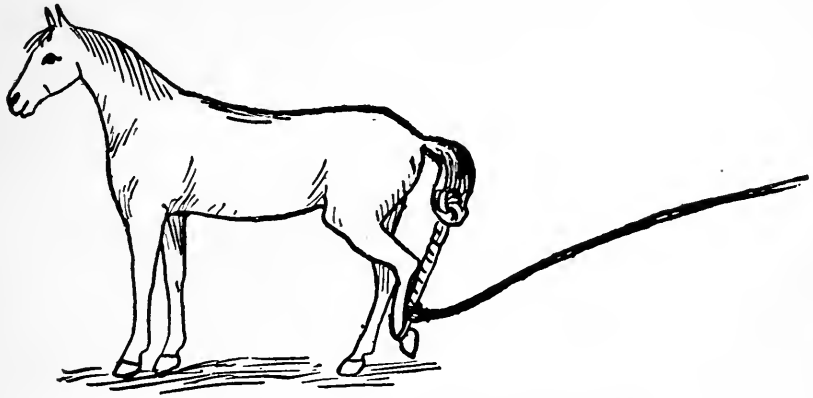
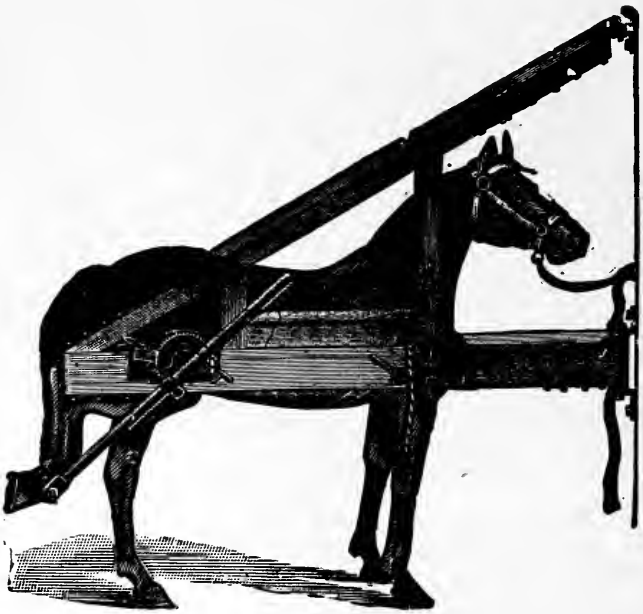


Figure 59 Device for Holding Unruly Horses

Shoeing racks are also manufactured and sold to farriers. The Barcus Stocks manufactured by George Barcus & Co., Wabash, Ind., is the simplest and most convenient device for holding vicious horses. See illustration.

No shoer should lose his temper in handling a nervous or vicious horse, and abuse the animal, for in nine cases out of ten hard treatment will irritate the horse and owner, too. Do not curse, be cool and use a iittle patience. To a nervous horse talk gently, as you would to a scared child. The horse is the noblest and most useful animal to man, but is often maltreated and abused. Many a man has no truer friend than the horse. Then treat him as a friend that never will go back on you. A friend that will carry both you and your burdens, patient, long suffering, willing beyond

strength and endurance. Be a gentleman, even in your treatment of the horse.



OVERREACHING

Forging, or overreaching, is a bad habit, and a horse with this fault is not very valuable. "Clack forging" is meant by the habit of clacking the hind and fore shoes together. This kind of forging is not serious or harmful; it will only tend to wear off the

toe of the hind foot and annoy the driver, possibly fatiguing the horse a little. The position of the foot at the time of the clack is different from what it is supposed to be. The toe of the hind foot is generally worn off while no mark is made on the fore foot. From this we understand that the hind foot never touches the heel of the front foot, but the shoe. Just at the moment the fore foot is raised up enough on the heel to give room for the hind foot to wedge in under it, the hind foot comes flying under the front foot, and strikes the web of the shoe. This is the reason no mark is found on the front foot, while the hind foot is badly worn off. Overreaching can be overcome by shoeing, but the shoer must know what overreaching is. Overreaching is simply this: the horse breaks over with the hind feet quicker than he does with the front feet. In other words, he has more action in the hind than he has in the front feet, and the result is that the hind feet strike the front feet before the latter can get out of the way, often cutting the quarters badly, and giving rise to quarter cracks and horny patches over the heels. Overreaching means that the hind feet are crowding the front feet, and the remedy is: increase action in front, retard action in the hind feet.

There are many different ideas about the remedy for this fault, and I am going to explain some of them in order that the reader may judge for himself which method is the best.

One method is to shoe heavy forward and light behind. This is not exactly a bad idea, but it is not heroic enough to help except in light and sensitive cases. Another method is to shoe with sideweight shoes on the hind feet; the weight of course to be on

the outer side of the shoe. This is not a bad idea, and will, in many cases, help but it should be remembered that sideweights do not affect the gait except in a swift trot.

Figure 61
Wrong Method of Shoeing Hind Foot for Overreaching

Toe weights on the fore feet is another method, but this way of shoeing is not of much value. The remedy must be such that it will increase action in front and retard action behind. Toe weight will not accomplish this.

The most culpable practice is that of shoeing with short-heeled shoes in front, and setting the hind shoes well under the foot, letting the toe stick out over the shoe on the hind feet. This is the idea of a remedy that strikes the mind of the average horseshoer first. It is the easiest way to get rid of the case, but the fault is aggravated, not cured. (See Fig. 61.) So high an authority as A. A. Holcomb, D.V.S., in the work, *Diseases of the Horse,* published by the Agricultural Department, at Washington, has recommended this absurd method, totally unproductive of any good. The shoe should never be set back under the toes of the hind feet. It will in most cases be found that the hind feet of overreaching horses are shorter from the coronet to the toe than the front feet, and have been stubbed off, as shown in Fig. 62.

Figure 62
Worn Hind Foot

The only way to stop overreaching is to make the hind foot longer than the front foot, the toe, or break-

ing-over point, being set forward not under the center of the foot, as is done by the incorrect method just mentioned. The hind foot being shorter and the breaking-over point nearer the center of the foot the hind foot breaks over quicker than the front foot, and the result is overreaching. To remedy this we must find a way by which we can lengthen the toe of the hind foot and shorten the toe of the front foot. The front foot should be leveled, the wall pared down as much as it will stand and the toe shortened. This

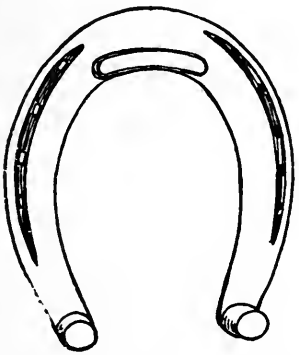


Figure 63
Front Shoe for Overreaching

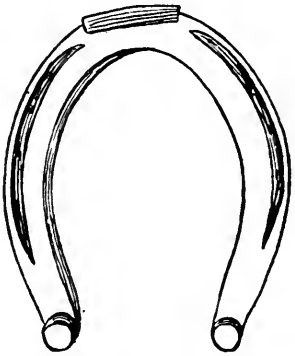


Figure 64
Hind Shoe for Overreaching

done, make a shoe as shown in Fig. 63. It will be seen that the toe-calk on this shoe is at the inner side of the web. This will set the breaking-over point back nearer the center of the foot and increase action in front. The toe-calks should be as short as possible with high heel-calks. The hind feet should be leveled and the heels rasped down as low as is advisable, leaving the toe long and high. The shoe should be made as shown in Fig. 64. It is noticed that this shoe is long, high toe-calk and low heel-calks. In nailing this shoe it should be set out on the toe to fully make up for any shortness in the foot and to stiffen the

joint, which will retard action. (See Fig. 65.) The shoe should also stick out behind; the idea being to shoe with a long shoe and set the breaking-over point

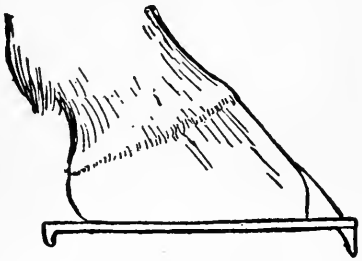


Figure 65
Right Method of Shoeing Hind Foot for Overreaching

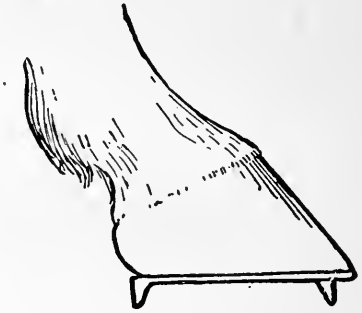


Figure 66
Right Method of Shoeing Front Foot for Overreaching

forward. The result of this is a slow action in the hind foot, and this accomplished, the fault is remedied. This method is a sure cure for overreaching, if the idea is properly carried out.

CHAPTER XIX.

MULES AND MULE-SHOEING

The term mule in its ordinary acceptation is generally employed to designate the offspring of "cross" between the equine and asinine species. Mules are of two kinds: the mule proper, which is the hybrid product of a male ass with a mare; and the hinny, which is the offspring of a stallion and a female ass. The mule proper is the more valuable of the two, and it is to its production the attention of breeders is directed. Breeding of mules is difficult, owing to the antipathy of the equine species to the asinine. Besides this, abortion readily occurs and more care must be taken during pregnancy in breeding mules than is necessary in breeding horses or asses. The mule foal does not grow as fast, nor is it as strong on its limbs as the horse foal. It is of no use before it is four years old, because it is longer in reaching maturity; but it is useful for a longer period than the horse, often working until it is fifty years old, and will live till seventy-five. The mule and the ass enjoy an extraordinary immunity from disease. In the campaign in Egypt in 1882, the English horses suffered very extensively from malarious fever, but the mules were entirely exempt. In our own late war the same conditions obtained. Nevertheless those diseases which attack the asinine species, generally run their course with great rapidity. Glanders, for example,

often appears in the chronic form in the horse, while in the mule and ass this disease is most acute.

Mules are reared in North and South America, and the districts for breeding in the United States are Kentucky, Kansas and Missouri.

The foot of the mule is different from that of the horse. In front it is round, but from the quarters back to the heels it is straight and perpendicular, having the shape of a contracted foot of a horse. In shoeing care should be taken that the hoof is not allowed to grow out too long. The heels should be pared down so that the frog is allowed to touch the ground. Mules often go lame on account of the heels growing almost together, pressing against the navicular bone, and causing contraction and corns. The shoes should be made in the shape as shown in Fig. 67, otherwise shoe as a horse.

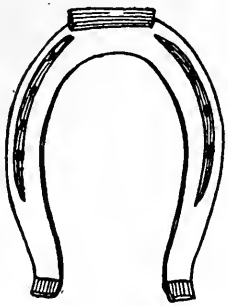


Figure 67
Mule-shoe

OXEN

Oxen seem to have been the first of the domesticated animals, and were undoubtedly one of the most important agents in the development of early history. We find them mentioned in the oldest written records of the Hebrew and Hindu peoples, as well as figured on Egyptian monuments raised 2,000 years before the Christian era. Remains of domesticated specimens have been found in the Swiss lake dwellings, together with stone implements and other records of Neolithic man. In early communities an individual's wealth was measured by the number of cattle he possessed. Abraham, it is said, was rich in cattle. Oxen for a

long period formed, as they still do among Central African tribes, the favorite medium of exchange between individuals and nations. After the introduction of metal money into ancient Greece, the former method of exchange was commemorated by stamping the image of an ox on the new money. The same custom has left its impression on the different languages of Europe. The English word "pecuniary" and the Swedish word "pekuniara" are derived from "pecus"—cattle. The value the ancients attached to the ox is further shown by the sign of the Zodiac, in which a bull figures. The bull, according to the Hindus, was the first animal created by the three divinities, who were directed by the Supreme Deity to furnish the earth with animated beings. The ox also played an important part in Greek and Roman mythology. The Hindus were not allowed to shed the blood of an ox. The Egyptians could only do so in their religious sacrifices to their gods. Hindus and Jews were both forbidden in their sacred writings to muzzle the ox while treading out the corn. To kill an ox wantonly was regarded as a great crime, punishable with exile among the Romans.

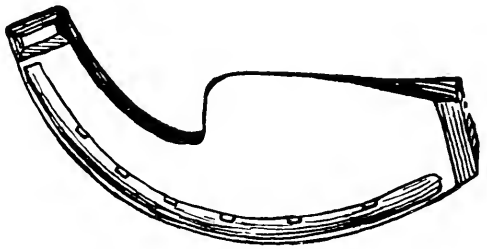


Figure 68 Ox-shoe, Right Half

OX-SHOEING

Since the ox has become a burden-carrying animal it has been found necessary to shoe his feet, in order to protect them against a foot wear detrimental to his usefulness as well as health, and to give him a sure

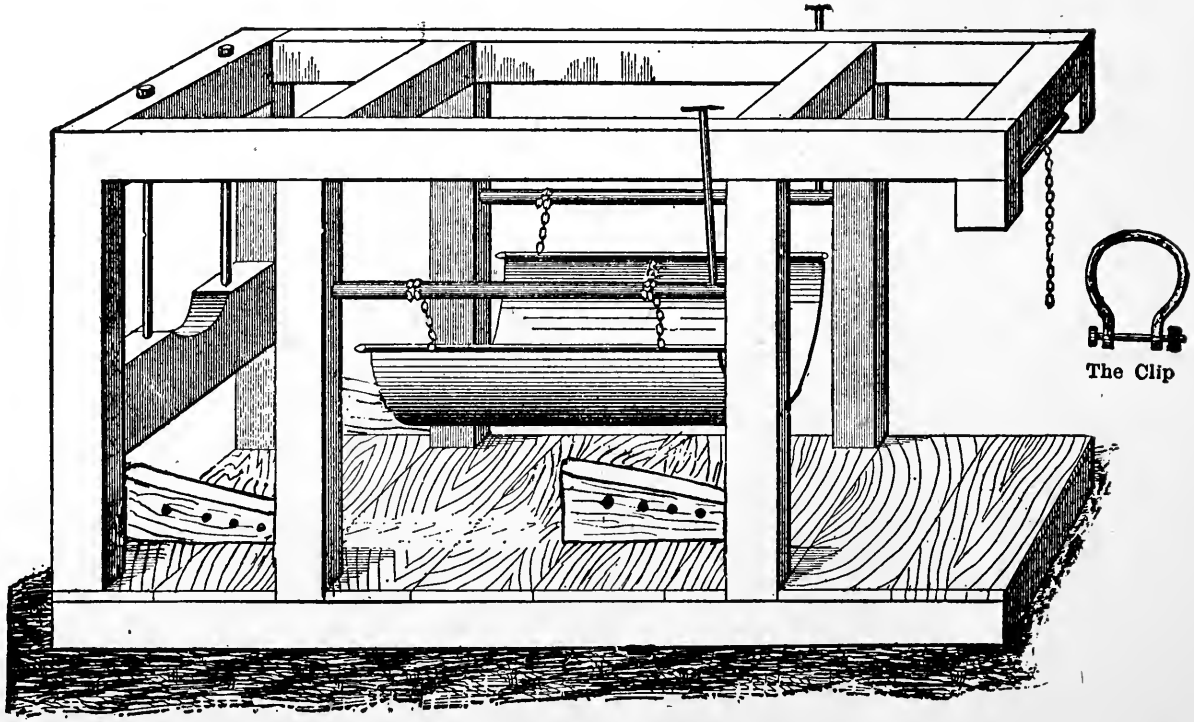


Figure 69 Ox Rack

foothold on icy or slippery roads. The ox being a less intelligent animal than the horse, must be shod in a different manner. In shoeing, the ox must be put in

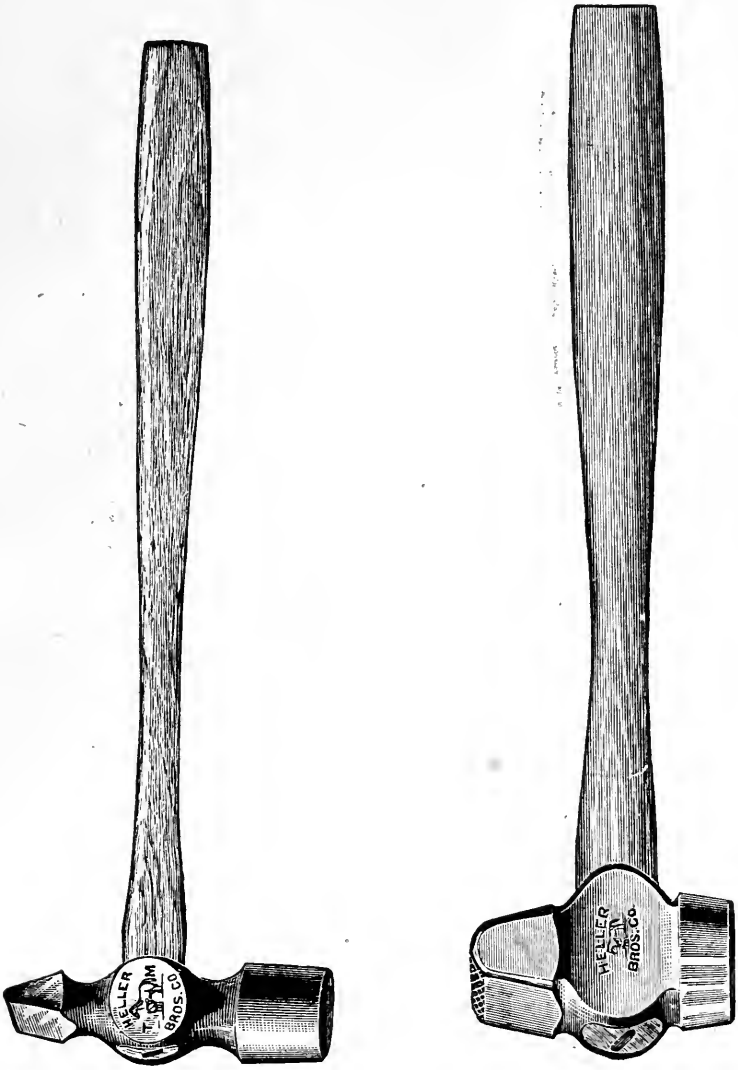


Figure 70 Figure 71

Heller Bros'. Hammers for Horseshoers

a stall or rack, where he is firmly held in a position from which there is no escape while the shoes are put on.

OX-SHOES

The first thing to be done when the oxen is brought to the shop is the making of the shoes. Ox-shoes

Figure 72

Figure 73

Heller Bros'. Hammers for Horseshoers.

are different from other shoes, being made in halves, one half on each claw, thus the claws will be free and

independent of each other, as in the unshod condition. Ox-shoes should be made of iron or soft steel $1\frac{1}{2}''\frac{5}{16}''$, narrow at the toe and wide at the heel, as shown in Fig. 68, with six nail holes for No. 5 nails. In preparing the foot for the shoe care should be taken not to rasp off too much from the foot, as the horn is thin, and if it is worn some it is still thinner. Rasp just as little as possible in order to get a bearing for the shoe. The shoe should also fit to the edges of the feet well. In nailing the shoes care must be taken not to drive the nails in to the quick. The shell is thin, especially at the heels. Do not draw the clinches hard, and remove the chip under the clinch with a narrow chisel. Do not rasp after the shoe is nailed.

Figure 74
Heller Bros'. Hammer
for Horseshoers

SHOEING RACK

In Fig. 69 a shoeing rack is represented that will be found effective in holding any ox while shoeing. The size of the timber is 10 inches square, 12 feet long, posts 8 inches square, 8 feet high. The blocks on the sides are for the feet to rest on held by the clevis. The illustration explains itself.

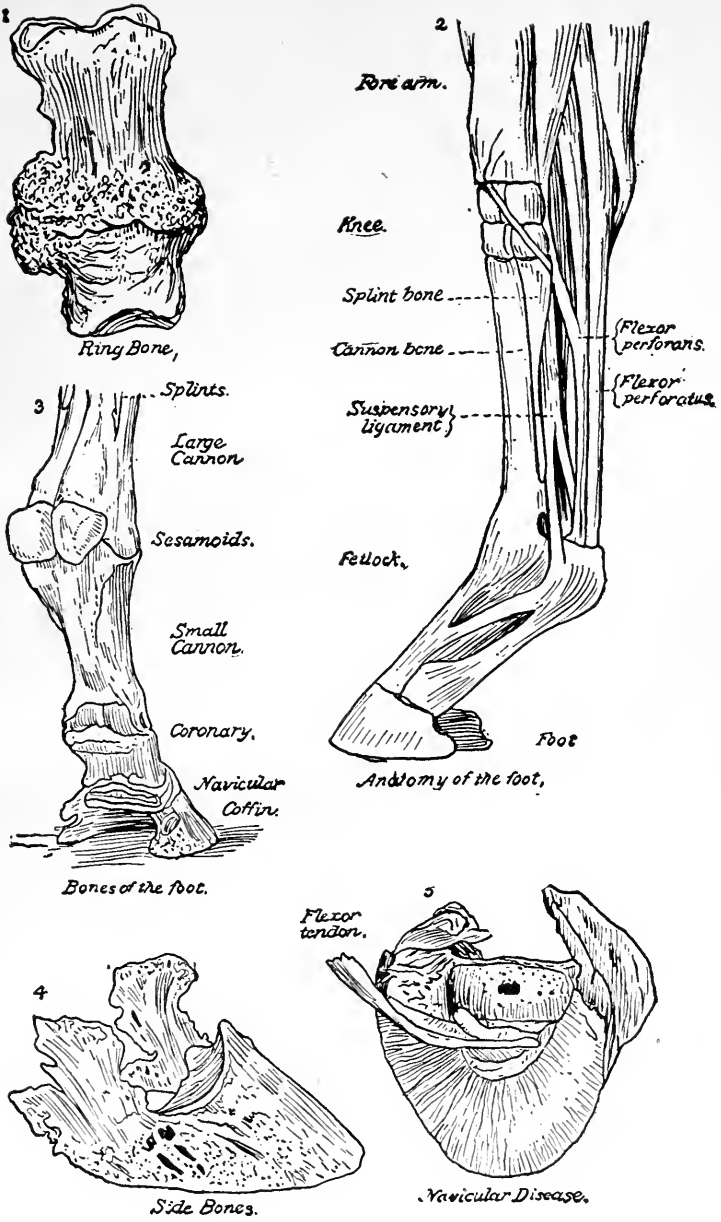
TRUSH

Trush is a nasty disease of the foot, secreting unhealthy and offensive smelling matter from the cleft of the frog. All classes of horses are more or less subject to this disease. The cause of the disease is mostly the filthy and unclean condition of the stable in which the animal is kept. Mares are liable to contract the disease in the hind feet, while the gelding and the stallion will develop it in the fore feet. Hard work on hard roads, a sudden change from dryness to excessive moisture may also induce this disease. The treatment consists in cleanliness. The diseased parts are to be pared away, the foot should then be poulticed for a day or two with boiled turnips, to which should be added a few drops of carbolic acid and a handful of powdered charcoal to absorb the secretion and destroy the offensive odor. The cleft of the frog should be filled with dry calomel, and the foot dressed with oakum and a roller bandage, which may be changed every other day. A long run in a clean pasture is a good thing. Shoes with high calks should be used when the horse must be shod, in order to raise the foot out of the mud as much as possible. Shoes with common calks should be restored when the disease is cured.

MANGE

Mange is a skin disease, caused by an insect lodged in the skin, producing terrible itch and scab, causing the hair to fall off in patches, and the horse to rub against everything.

Wash the affected parts in soap water quite warm, dry and then rub in the following ointment: oil of tar, 4 ounces; sulphur, 6 ounces; linseed oil, one pint.



RING BONE AND NAVICULAR DISEASE

Plate 32

WORMS

Worms are of several kinds. Three kinds of tapeworms and as many as seven kinds of other worms have been found in the horse. For common worms give the following: calomel, one drachm; tartar emetic, one drachm; sulphate of iron, one drachm; linseed meal, half a pound. Mix and give in one dose for a few days, then give a purgative. This should be repeated in three weeks to get rid of the young worms left in the bowels in the form of eggs, which have since hatched out.

LICE

Make a strong tea of tobacco and wash the horse all over with it, and the lice will die.

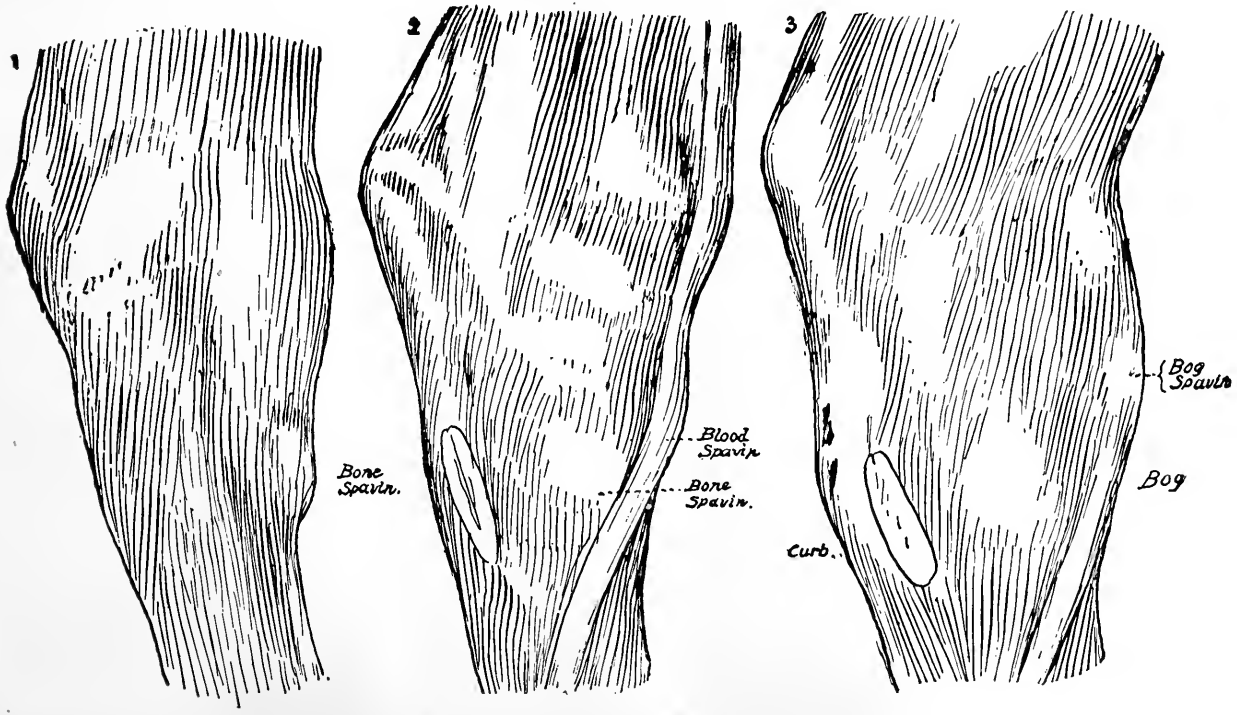
BOTS

For bots give a strong purgative for a time or two.

COLIC

Colic is a very common disease, divided into two kinds: spasmodic and flatulent. In spasmodic colic the pains are spasmodic; there are moments of relief when the patient is free from pain. Flatulent colic is recognized by bloating symptoms, and the pain is continual; the horse kicks, paws, tries to roll and lie on his back. Treatment for spasmodic colic: laudanum, ½ ounce; whiskey, ½ pint; water, ½ pint. Mix well and give in one dose. If not relieved in half an hour repeat the dose.

For flatulent colic: laudanum, ½ ounce, turpentine, ½ ounce; raw linseed oil, ½ pint; chloroform, ¼ ounce; water, ½ pint. Mix and give in one dose Repeat in one hour if not relieved.



VARIOUS TYPES OF SPAVIN.

Plate 24

DISTEMPER

Distemper is a disease of the blood. Symptoms: swelling under the jaw, inability to swallow, a mucous discharge from the nose. Treatment: give the patient a dry and warm place and nourishing food. Apply hot linseed poultice to the swellings under the jaw and give small doses of cleansing powder for a few days.

HYDROPHOBIA

As there is no remedy discovered that will cure this horrible disease, the patient should be destroyed as soon as a case has been satisfactorily recognized.

RINGWORM

Ringworm is a contagious disease, and attacks all kinds of animals. The cause is poverty and filth. It first appears in a round bald spot, the scurf coming off in scales. Treatment: Wash with soap and water and dry. Apply the following once a day: twenty-five grains of corrosive sublimate mixed in ½ pint of water; use till a cure is effected.

INABILITY TO URINATE

Symptoms: the patient is looking around on his sides, tries to urinate, lies down, rolls and stretches. Treatment: alum, ½ pound; oil of camphor, 3 drachms. Mix and give in three pills. Give one a day with a drench made of three spoons of saltpeter and one quart of water, divided into three doses; one a day to be given.

RATTLESNAKE BITE

When a horse has been bitten by a venomous serpent, such as a rattlesnake, copperhead, or other

Sound hock.

Cured spavin.

Spavin.

Spavin.

BONE SPAVIN.

Plate 26

snake, give the following: Hartshorn, 1 pint; whiskey, 1 pint, warm water, ½ pint. Mix and give in one dose. Repeat in one hour if not relieved. The wound should be burned at once with a hot iron, and a sponge soaked in ammonia kept on the wound for an hour or two.

HOOF OINTMENT

Mutton tallow, 4 ounces; resin, 4 ounces; pine tar, 4 ounces; fish oil, 4 ounces; beeswax, 4 ounces. Mix well and apply every night.

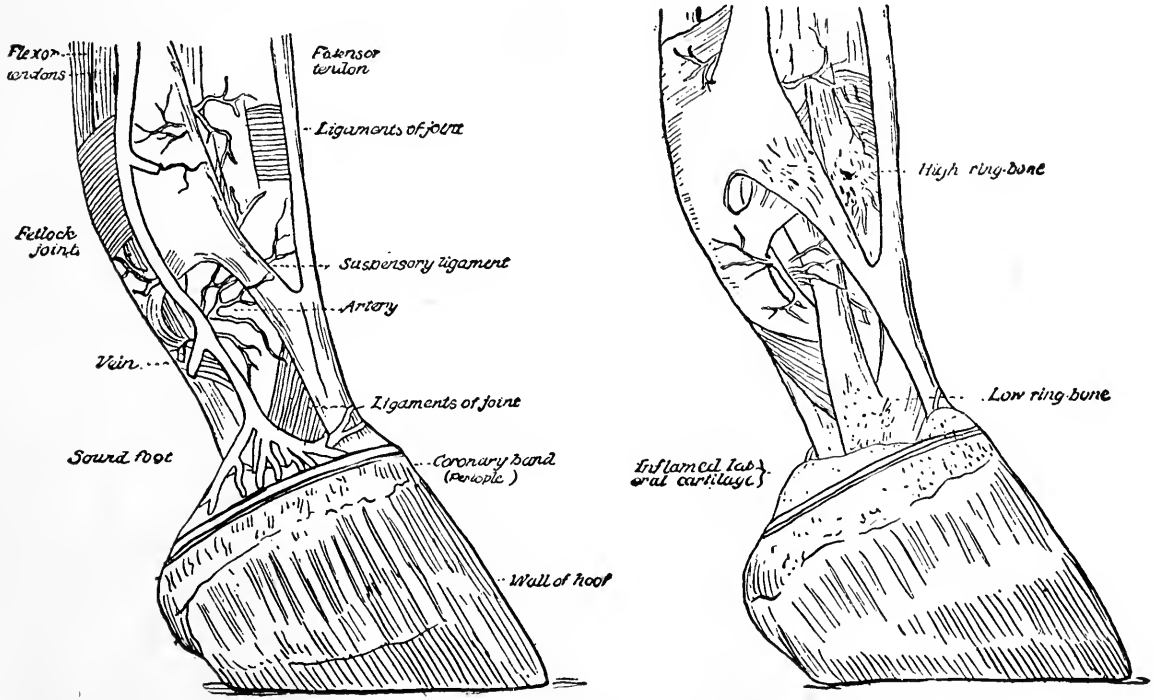
PURGATIVE

Aloes, 3 drachms; ginger, 1 drachm; gamboge, 2 drachms; gentian, 1 drachm; molasses to combine in a ball. Give in one dose.

BALKING

Balking is generally the result of abuse. The horse has been overloaded and then whipped to make him perform impossibilities, which he resents by balking.

Many cruel methods for curing this habit have been tried, but kindness is the most successful. A balking horse should not be hitched to a load he cannot pull. The man that is used to the horse should drive him. When a balking spell comes on it is best to try to divert the mind of the animal from himself. A little tinkering around the horse, such as lifting the harness, pulling in the different straps, talking to him, and sometimes a handful of oats. But if there is no time to spend this way, pass a rope or chain around his neck and pull him along with another horse. If this has been done once the next time the horse will generally start at the sight of the chain, or rope, as the case may be.



RING-BONE.

Plate 23

SPAVIN

Spavin is a disease divided into four kinds: bone spavin, bog spavin, blood spavin and occult spavin. (See Plates 24 and 26.)

RING BONE

Ring bone is a disease of the coronet, caused by hard labor in early life, blows, bruises and sprains. Call a veterinarian as soon as a case is recognized. (See No. 1, Plate 32.)

DOCKING

It is, and has been for some time, the fad to ride behind a horse with a docked tail. That this fad is

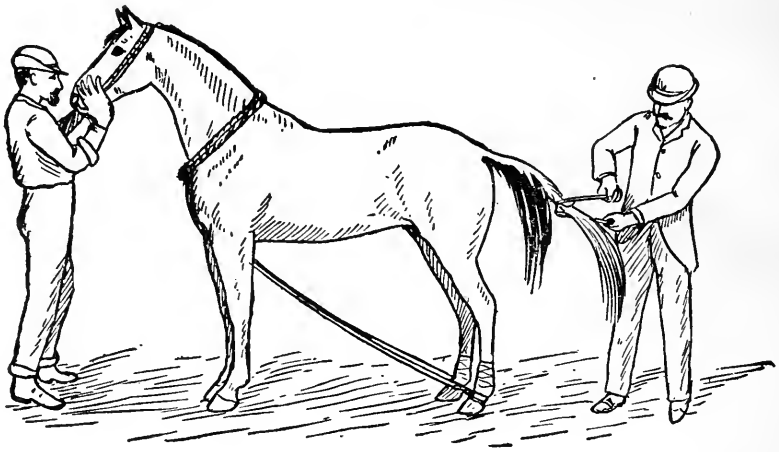


Figure 75 Docking

cruelty to animals is a question already settled by our societies for the prevention of cruelty to animals. I will not describe the mode in which the horse is so

mutilated and robbed of his only defence against insects, as well as a very ornamental part of his anatomy. Let no man be so cruel as to dock his horse.

Figure 76

Figure 77

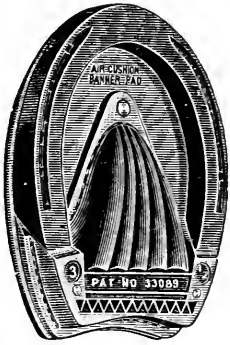


Figure 78

Rubber Pads Made by Revere Rubber Co.

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